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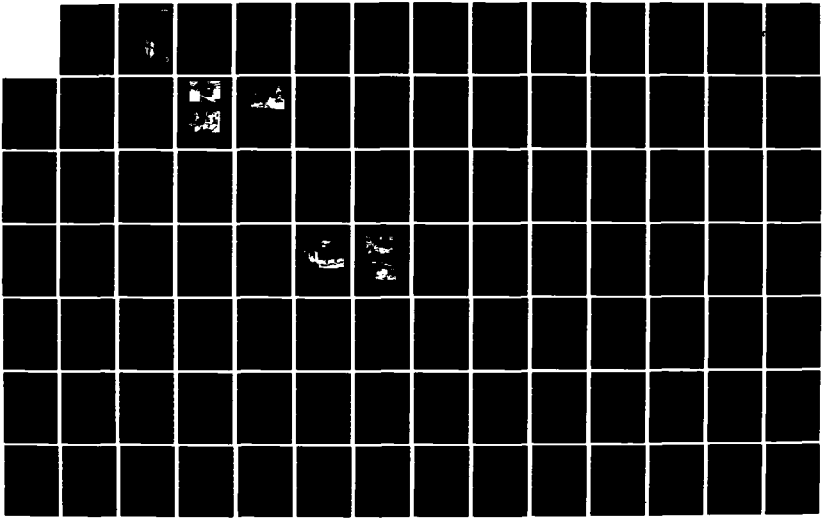

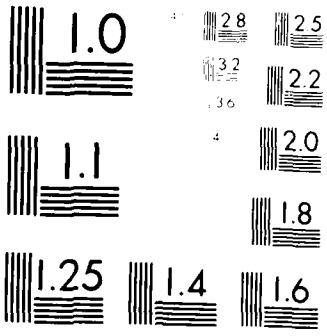

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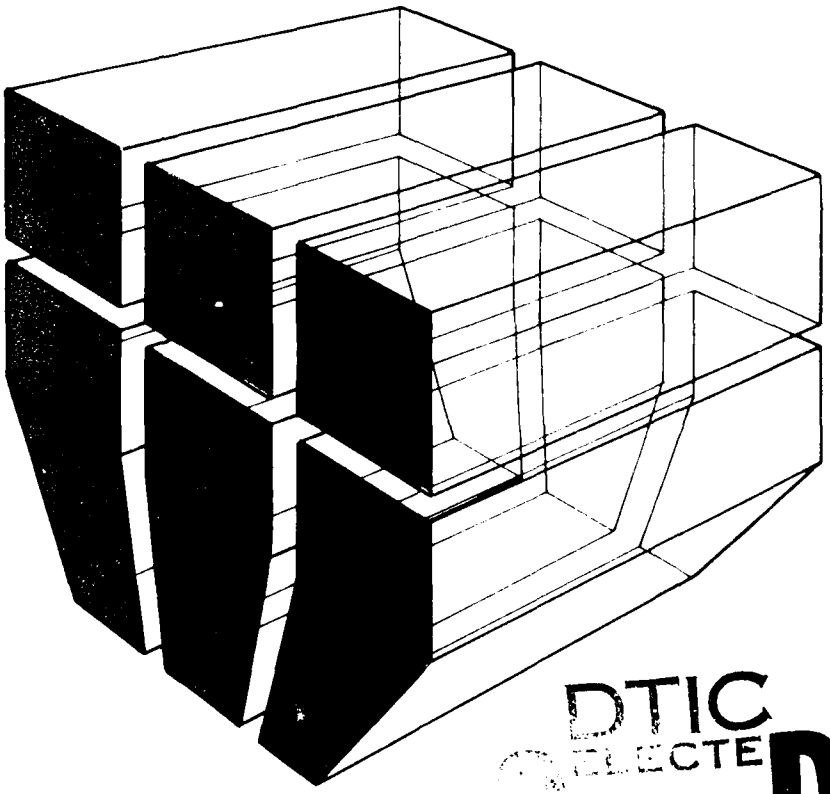
TECHNICAL REPORT P-85/09
December 1984

DESIGN OF COMPUTER-RELATED WORKSTATIONS IN RELATION TO JOB FUNCTIONS AND PRODUCTIVITY

by
Charles C. Lozar
Robert D. Neathammer



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This research analyzed offices at the Defense Systems Automation Center, Defense Logistics Agency, Columbus, OH, to determine workstation design criteria for computer-related job functions. This was done by determining the functional needs of employees and by a "before" and "after" renovation evaluation of a prototypical workstation area. The prototype was compared and evaluated to control groups. Certain hypotheses about spatial adequacy, privacy, and productivity were tested within the limits of the control group and

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the overall survey. The results of this analysis were related to previous research and then transplanted into recommended design actions which can be interpreted by interior designers, architects, and office managers. This will improve performance in computer-related job functions through layout, furnishings selection, and support services within the physical envelope and the management structure of the organization.

FOREWORD

This research was conducted for the Defense Logistics Agency, the Defense Systems Automation Center, Columbus, OH, under MIPR 80-939-5, dated January 1981. The work was performed by the Facility Systems Division (FS), U.S. Army Construction Engineering Research Laboratory (USA-CERL).

Appreciation is expressed to Mr. William Young, Deputy Director of DSAC for his support and cooperation. Mr. E. A. Lotz is Chief of USA-CERL-FS. COL Paul J. Theuer is Commander and Director of USA-CERL, and Dr. L. R. Shaffer is Technical Director.

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DESIGN OF COMPUTER-RELATED WORKSTATIONS IN RELATION TO JOB FUNCTIONS AND PRODUCTIVITY

1 INTRODUCTION

Background

The Defense Logistics Agency, Defense Systems Automation Center (DSAC), in Columbus, OH, employs 450 people to develop management protocols on computers. These protocols are later turned into programs to handle logistics requirements for the Department of Defense (DOD). This central processing agency is the source of all computer programs used for logistics support within DOD.

The DSAC employees work in a portion of a large warehouse building. The DSAC management felt that if the physical setting of personnel workstations were improved, employee productivity would increase. Therefore, they asked the U.S. Army Construction Engineering Research Laboratory (USA-CERL) to design and implement a prototype area which could be used to determine design criteria for new workstations. The USA-CERL study centered on the most appropriate types of workstations to support the various employee job functions. DSAC job functions are generally categorized as manager, computer programmer, computer analyst, functional analyst, and other support staff.

DSAC job functions require people to spend up to 40 percent of their time at their workstation, performing some level of mental task. The workstation requirements of individuals involved in high-level mental concentration tasks, such as computer-related work, are need for privacy, absence of distraction, and visual stimulation by the environment.

DSAC was interested in identifying the major parameters and variables which could be manipulated to increase the productivity, efficiency, and effectiveness of personnel in computer-related job functions. USA-CERL's task therefore became one of developing guidance for designing this type of workstation and identifying appropriate design criteria for an office area containing 450 people doing similar work. This study expands upon previous work[1] and can be applied to developing and designing workstations for other specific job functions.

Objective

The objectives of this research were (1) to develop a prototype for a logical office workstation layout and arrangement for computer-related job functions at DSAC and (2) to use the information gained from studying the

[1] C. Lozar and R. Porter, Developing Habitability Information for the Design of Office Environments, Technical Report E-142/ADA074467 (U.S. Army Construction Engineering Research Laboratory [USA-CERL], 1977).

prototype to develop designs for renovating the entire DSAC computer office area.

Approach

The literature was searched to determine previously developed design criteria for office workstations. A plan for conducting the DSAC study was then developed. The goals of the study were set and the plans coordinated with DSAC management. Data were collected and analyzed to determine employee needs. Results of the analysis were used to design a prototype area which was occupied by selected employees for 6 months. The prototype was evaluated by comparing employee opinions from before and after the renovation. The results were used to recommend design criteria. A productivity model was developed to help evaluate how changes in environment affect employee productivity.

Scope

This project was limited to developing workstation design guidance only for computer-related job functions. The term "computer-related" implies that the employee works with terminals either at his* desk or in a common area, that he works with the logic of developing a program, and that the output he works with is a computer listing. Most job functions (75 percent) at DSAC have these characteristics. Therefore, functional differences between jobs are addressed as they are related to design. These job functions do not include word processing centers or learning centers which use computer support technology. In determining the design criteria, specific measures for productivity were limited to satisfaction indices with workstations and management climate.

*The masculine pronoun is used throughout this report to refer to both genders.

2 IMPACTS OF COMPUTER TECHNOLOGY ON THE WORKSTATION

Computer-based office systems and related technologies are quickly becoming the largest and most complex segment of facility management's design responsibility. In large organizations, use of computer-connected, video display terminals alone is doubling every 3 or 4 years, because they improve productivity. However, this new technology frequently causes more confusion in layout, arrangement, and personal interaction. Its rapid expansion into the physical environment has an impact on responsiveness, physical workstation needs, and personnel efficiency. Therefore, designers must first try to evaluate these changes before developing new workstation designs.

When computer-related support systems are introduced, some basic assumptions can be made about how they will affect workstation design:

1. The computer terminals and related materials at management-type workstations will require 30 to 50 percent of the available work surface area but handle only 5 to 20 percent of the transactions. At other workstations, particularly those of computer programmers, terminals will handle 85 percent of the work-related transactions.

2. The major paper-based work will change from producing cumulative documents to producing informative documents with computer listings; this will determine the size and area of the workstation required. In a "paperless" office, messages can be handled electronically. This eliminates the need for small notepads and letterheads. However, at DSAC, a large shelf area will still be required for output listings.

3. Use of computer terminals affects vision and lighting and affects the design criteria for energy conservation and use of natural daylight. Glare is a major problem and must be balanced against task and ambient lighting requirements.

4. Computer technology will change the way individuals relate to other workstations. This will change individual requirements for privacy, control of privacy, and symbolic territorial boundaries.

5. The introduction of electronic technology can dramatically change how operations are performed. It will change some of them from being more individual to being team-oriented, interactive-based work situations.[2]

[2] Journal of Facility Management, Facility Management Institute Occasional Paper [illegible] (1980).

[illegible] Review

[illegible] few [illegible] studies have dealt with the problem of developing de[illegible] criteria for office [illegible]. These studies which dealt with the [illegible] environment focused [illegible] space planning and affective behavior. They [illegible] with [illegible] relationships between sociopsychological factors and [illegible] the recognition of the importance of work[illegible] in enhancing the productivity and effectiveness of office work[illegible].

[illegible] have determined the general perceptions of office occu[illegible] [illegible] changes to offices during the 1980s. The changes [illegible] of increased office automation in the work[illegible] and facilities.

[illegible] to fulfill the needs of computer pro[illegible] different specific design criteria can be used [illegible] each arrangement has advantages and disad[illegible]. [illegible] anthropometrics data as a basis for developing [illegible] the amount of floor area required for certain [illegible] that different interpretations of job re[illegible] space and furnishing requirements. Another [illegible] criteria for open office planning and com[illegible] aspects of privacy, professional image, social[illegible] conferencing within a team. The [illegible] changes in the technology-based office of [illegible].

[illegible] design criteria for workstations and [illegible] productivity. This study is surveying [illegible] increasing office productivity by ap[illegible] design criteria. Four types of [illegible] open office with freestanding parti[illegible] and traditional private offices. By using [illegible] hope to see changes in produc[illegible] changes in the physical environ[illegible].

[illegible] design criteria for developing [illegible] for a typical computer program[illegible] general job function characteristics [illegible].

[illegible] in the Office of the [illegible] II (Steelcase, Inc.,

[illegible] Special Needs of Computer [illegible]

[illegible]," Buildings (May 1980).

[illegible]," Architectural Record [illegible].

[illegible] Development Center: Programmer [illegible] (IBM, 1976).

[illegible]

88.	Conversations in my room disturb my ability to concentrate.	___	___	___	___	___	20
89.	I can hear noise thru the walls of my office.	___	___	___	___	___	21
90.	People keep coming into my room and disturbing me.	___	___	___	___	___	22
91.	The telephones in my room are a noise irritant.	___	___	___	___	___	23
92.	I have a high degree of control over my privacy in my room.	___	___	___	___	___	24
93.	I have many visual distractions in my office which are disturbing.	___	___	___	___	___	25
94.	My job requires a high degree of concentration.	___	___	___	___	___	26
95.	Total number of people in my room is _____.	___	___	___	___	___	27
96.	Number of people I can see while sitting at my desk is _____.	___	___	___	___	___	28

Figure 6. Privacy at workstation (data represents the mean for all respondents combined for all office conditions).

to rate responses to the overall room, which gives an idea of the character of the workstation environment. There are no windows in the room, which accounts for the neutral ratings on that question. The floors, ceilings, and all walls were given low ratings, and all utilities and services except lighting were all rated quite low. However, it must be remembered that the room contains about 30 people working either individually or in small groups.

Figure 6 shows ratings for privacy questions. The general ratings for "privacy in workstation" are generally negative. The strongest responses were lack of "control over privacy" and being able to "hear noise through the walls" of the offices. The environment did not seem to be exceptionally noisy; however, since the rating for "job requiring a high degree of concentration" is quite high, even a low perceived noise level may be annoying to the respondents.

Each respondent referred to the total number of people in the room as being a moderately sized team group. However, the response to "number of people one can see while sitting at the desk" was about five, indicating that there is a lack of interworkstation partitions to cut down visual distractions. One interesting observation is that neither telephones nor "people coming into my room disturbing me" are perceived as a "noise irritant." Thus, it is quite possible that these are not detrimental to privacy levels, since both are probably job-related conversations or calls. However, being able to hear and see other conversations and calls appears to be one of the major factors contributing to the privacy problem.

Function and Physical Requirement Differences

Tables 1 through 16 summarize analyses of responses concerning workstation activities and needs according to job function levels. Most responses relate directly to differences for physical requirements by job function level. Each tabulation is identified by the respondent within each cell, as well as by whether there are significant differences (using a chi-square statistical test) among job functions. Inspection of these differences will give insight into the various functional needs of each type of workstation. These are used to draw design implications for selecting interior furnishings.

Regression Model Differences By Job Function

A series of regression models was run to determine which factors are important in explaining satisfaction with workstation space, furniture, and privacy. The first regression runs (summarized in Table 17) show the comparison of the regression models run for all respondents by job function; the dependent variable is "area their space occupies as being adequate for their activities." This regression model included the variables of satisfaction with furniture, desk size, storage space adequacy, flexibility of workstation, and adequate privacy. These variables were selected because they were all related to design of the space in and around the workstation. Space is a major determinant of facility construction cost; therefore, it was

FLOORING IN ROOM

64.	Satisfactory	___ : ___ : ___ : ___ : ___ : ___ : ___	Unsatisfactory	67
65.	Clean	___ : ___ : ___ : ___ : ___ : ___ : ___	Dirty	68
66.	In good repair	___ : ___ : ___ : ___ : ___ : ___ : ___	In good repair	69
67.	Attractive	___ : ___ : ___ : ___ : ___ : ___ : ___	Unattractive	70

CEILING IN ROOM

68.	Satisfactory	___ : ___ : ___ : ___ : ___ : ___ : ___	Unsatisfactory	71
69.	In good repair	___ : ___ : ___ : ___ : ___ : ___ : ___	In poor repair	72
70.	Attractive finish	___ : ___ : ___ : ___ : ___ : ___ : ___	Unattractive finish	73

WALLS IN ROOM

71.	Satisfactory	___ : ___ : ___ : ___ : ___ : ___ : ___	Unsatisfactory	74
72.	Easy to clean	___ : ___ : ___ : ___ : ___ : ___ : ___	Difficult to clean	75
73.	In good repair	___ : ___ : ___ : ___ : ___ : ___ : ___	In poor repair	76
74.	Attractive finish	___ : ___ : ___ : ___ : ___ : ___ : ___	Unattractive finish	77
75.	Good quality paint	___ : ___ : ___ : ___ : ___ : ___ : ___	Poor quality paint	78

UTILITIES AND SERVICES IN ROOM

76.	Lighting adequate	___ : ___ : ___ : ___ : ___ : ___ : ___	Lighting inadequate	79
77.	Fixtures well located	___ : ___ : ___ : ___ : ___ : ___ : ___	Fixtures poorly located	80
78.	Switches well located	___ : ___ : ___ : ___ : ___ : ___ : ___	Switches poorly located	2 1
79.	Switches in good repair	___ : ___ : ___ : ___ : ___ : ___ : ___	Switches in poor repair	2

Figure 5. Evaluation of room conditions (data represents the mean for all respondents in all room conditions combined).

WORK STATION

[illegible]

16.	The size of my desk surface is adequate for my tasks.	19
17.	The area my space occupies is adequate for my tasks.	20
18.	I have enough storage space in and around my desk.	21
19.	I find my work station flexible enough to meet changing requirements.	22
20.	I think my work station presents a professional image.	23
21.	The privacy I now have is adequate for my tasks.	24
22.	My work station is an attractive arrangement.	25
23.	My work station is easy to keep clean.	26
24.	I do bring items from home to personalize my work area.	27
25.	There are no safety hazards associated with my work station.	28
26.	I associate a personal sense of pride with my work station.	29
27.	Someone else has a work station I would prefer rather than mine.	30

Figure 4. Evaluation of workstation in general (data represents mean for all respondents combined in all workstations).

card 1
col. 1-3
Quest. No. ___

FURNITURE

[illegible] your work station [illegible] furniture consists of a number of individual items [illegible] Please indicate your [illegible] disagree [illegible] following statements.

1.	My furniture is comfortable.	___	___	___	___	___	4
2.	I have a wide variety of furniture.	___	___	___	___	___	5
3.	My furniture is modern and stylish.	___	___	___	___	___	6
4.	My furniture is colorful.	___	___	___	___	___	7
5.	My furniture is easy to damage.	___	___	___	___	___	8
6.	My furniture is new.	___	___	___	___	___	9
7.	I am proud of my furniture.	___	___	___	___	___	10
8.	My furniture is sturdy.	___	___	___	___	___	11
9.	My furniture is high quality.	___	___	___	___	___	12
10.	I am satisfied with the furniture in my work station.	___	___	___	___	___	13

I have the following furniture in my work area (circle appropriate items)

11. Desk (14)
    1 grey-green
    2 Wood
    3 Black with colored top

12. Bookcase (15)
    1 Bookshelves
    2 Metal Bookcase

13. File Cabinet (16)
    1 2-drawer
    2 4-drawer
    3 Slide pullout
    4 Wright Cabinet

14. Other Equipment (17)
    1 Credenza
    2 Chairs
    3 Work Table
    4 Other

15. Partitions (18)
    1 Bank Screen
    2 Landscape Office
    3 Movable Freestanding
    4 None

Figure 3. Evaluation of furniture in workstation (data represents the mean for all respondents combined).

Ninety-nine percent of the respondents had the standard gray/green metal GSA desks. Almost all bookcases were the standard metal type. Supervisors generally had four-drawer standard file cabinets; computer programmers, systems analysts, and functional analysts each had a Wright file* and their desk drawers.

GSA standard floor planning criteria meant that common furnishings within the office areas for all groups were a chair, a desk, and a worktable. The only exception was that supervisors generally had a credenza. Lighting was usually from strong fluorescent lights in the ceiling. There was little evidence of task lighting at any desk. There was no carpeting except in a few supervisory offices which were allocated it by grade. The rest of the flooring was standard vinyl asbestos tile. Most of the working staff had no access to windows.

Overall Survey Results

The overall survey data represent the responses of 298 people about their satisfaction with the workstations before renovation.

Figure 3 shows survey results for the furnishings questions. The descriptive profile of the Likert scale represents the means of the 298 responses. This profile reveals that the lowest ratings of satisfaction are for "pride in furniture," "newness of furniture," "colorful," and "modern, stylish furniture." These low ratings generally are translated into the response to question 10; most respondents highly disagree that they are "satisfied with the furniture in their work station." The only relatively positive response is the rating of furniture as "sturdy"--a common characteristic of standard steel GSA furnishings. In previous surveys, the desk chair was identified as "comfortable." However, in this profile, the "comfort" rating borders on the neutral zone; in terms of general ratings, the rest of the workstation is rated much lower.

The workstation is defined as the physical space in or around the office equipment which the respondent occupies. Inspection of the ratings in Figure 4 indicates very little positive feeling overall. The extensive negative ratings for "professional image," "privacy," and "attractiveness" indicates a general dissatisfaction. Most DSAC employees perceive their job functions to be professional. The education level required to perform their job functions is usually quite high, so some extra weight should be given to their extremely low ratings of "professional image."

Figure 5 gives ratings for general room conditions. The DSAC workstation is located in a large room. The semantic differential technique can be used

*Wright files are large file cabinets with adjustable shelving for computer listings, notebooks, books, etc.

6 DATA ANALYSIS

Functional Types

Six job function levels were selected for analysis. The data were divided into subgroups and analyzed using the Statistical Package for the Social Sciences (SPSS) programs. The job function determinations closely follow DSAC job descriptions, but do not include all of each job's specific duties or its rating system. Their purpose was to provide general categories to identify various types of work being done. Because of the nature of DSAC's workload, each of the six job functions directly interfaces with some level of computer analysis. For example, the secretaries almost always had word processing capabilities at their workstations as well as access to a central work processing pool. The following are short descriptions of job types identified for analysis:

1. Supervisory Management. Supervise at either division or branch level; responsible for employee resource allocation and ratings.

2. Computer Programmer. Writes computer programs, fixes errors in them; shares computer terminals with other programmers.

3. System Analyst. Determines how the specifications for the functions can best be done in the computer system; designs the computer program, but does not program; shares terminals with other systems analysts.

4. Functional Analyst. Develops specifications for the functional area to determine required user inputs and outputs or products.

5. Clerk. Generally enters data into computer terminals; takes off coding sheets.

6. Secretary. Secretaries either work for one manager or for a team. All have access to central word processing through desk-top computer terminals.

The questionnaire used in this study (see the appendix) was set up to design offices that would improve employee satisfaction with their working environment. Of the 330 questionnaire respondents, 42.6 percent had private offices or their own office cubicles surrounded by bank screen partitions. The others worked in rooms with six or more people, which were sometimes team areas; most teams were in rooms with more than 40 people. Altogether, DSAC had five major large areas divided from each other by fire walls; each room had about 85 persons. This large number of people makes it reasonable to assume that various occupants would perceive their work environment differently.

Most people located in the open spaces of the room have some sort of bank screen partition to increase privacy. Forty-five percent of the computer programmers, 45 percent of the systems analysts, 60 percent of the functional analysts, and 30 percent of the data processing clerks have bank screens. The rest had no enclosing partitions.

3. New Desk Carrel Units. Flexible storage devices specifically designed for computer programmer and analyst job functions were installed. These cabinets have partitions which can be changed to accommodate different paper sizes and can be adjusted for different job functions. They matched the general color scheme and were attached directly to the top surface of the desk.

4. Desk Task Lighting. Adjustable fluorescent lights were installed under the desk carrel units for close illumination of computer listings. These lights will reduce energy consumption.

5. Partitions for Privacy. The metal screen partitions were repainted and refinished to provide a better visual environment and to increase occupant privacy. Since these people tend to work in a team-like environment, some lower panels with shelves were placed between workstations to accommodate quick interoffice communications.

6. Partition Blackboards. The translucent screens in the upper portion of the standard GSA partitions were replaced with a melamite panel on which dry markers could be used. This concept would provide the same type of work surface available in systems furnishings.

Data Collection

The experimental design selected was a simple comparison of "before" and "after" conditions in the prototype and control areas as follows:

	Prototype Group	Control Group
Pre-renovation	18 workstations	28 workstations
Post-renovation	Same workstations to be evaluated after a 4-month occupancy period.	

Both the experimental and the control groups were located in a large room (100 x 120 ft). The experimental group was in a compact area containing about 4400 sq ft. The control group was made up of individuals randomly selected in the same room whose job functions and types were similar to those of the experimental group. It should be noted that the control group was aware that the experimental group would get renovated furniture, and this may have had some effect on the results. Both groups were surveyed at the same time.

The evaluation period from the initial survey to the "post-renovation" condition survey lasted 14 months. The experimental group had occupied the prototype area for 6 months before they and the control group did the "after" survey.

5. ORIENTATION AND DATA COLLECTION

Orientation

The major objective of the design study was to provide the designer with information to improve workstation layout. A two-part approach was needed to effectively evaluate the major variables affecting the workstation design and the relationship of these variables to job functions.

The first part of the approach was a basic survey to determine how the variables related to the job functions of people who work closely with computer technology. The second part was an analysis of a "before-and-after" experiment to determine whether employees perceived any actual improvement in productivity after they were given new furniture.

An experiment was designed to implement this approach. A floor layout was planned and major variables were selected from the survey for "before" and "after" evaluation. The number of prototype workstations was limited by monetary and space constraints. The DSAC management selected a team-oriented group for the experiment. The group was a 20-person team made up of programmers, analysts, and support personnel.

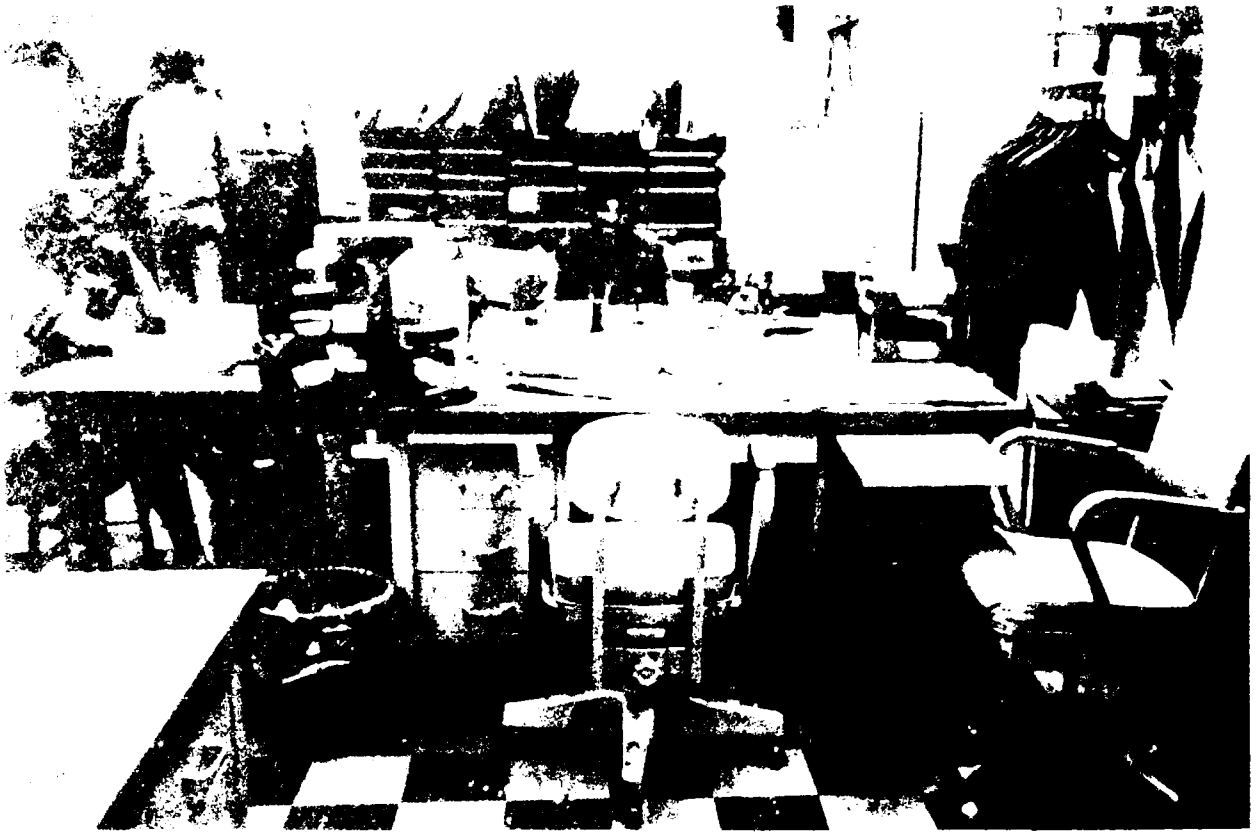
Based on a preliminary analysis of the survey results for 330 respondents, the most important variables for designing the prototype were determined. These variables were adequate space in and around the workstation, privacy, lighting, storage space, and reduction of noise levels. Next, a series of interviews and discussions was held with the participants to present the variables, get their comments, and translate this information into preliminary schematic floor plans. Final approval was then obtained to begin the renovation.

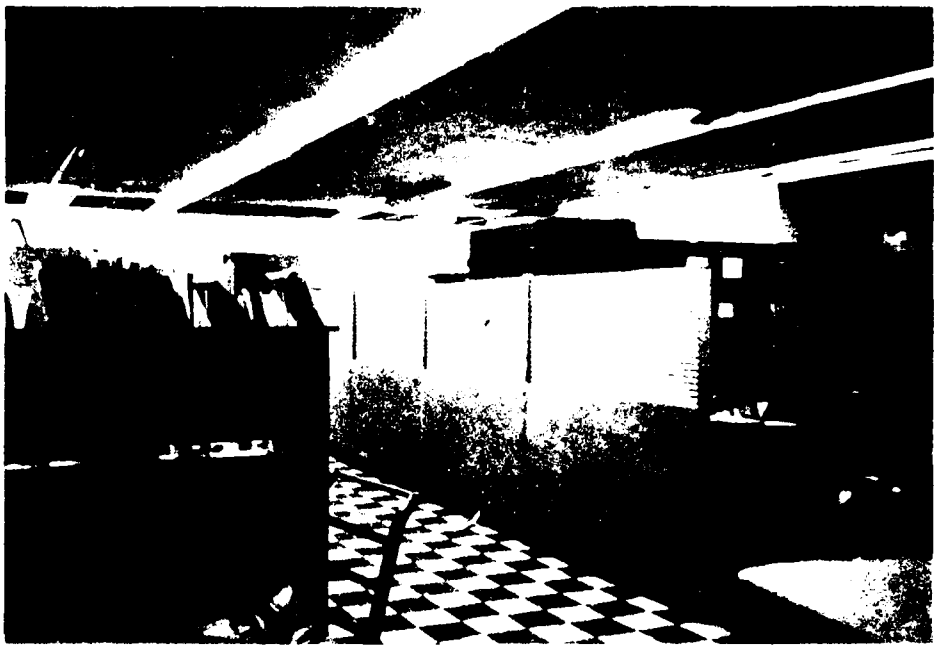
One of the major constraints of this study was the limitations of Government procurement regulations for furniture. Systems furniture* was not available on GSA schedules at the time of the study; therefore, another way of evaluating workstation variables had to be used. The variables were selected under the assumption that the Government might approve systems furniture; the variables would then be applicable to new purchases. Under the current DSAC constraints, however, the following design actions were implemented:

1. Wall Flocking. All standard panels were covered with a spray-on epoxy flocking which gave the appearance of soft-texture carpeting to the metal panels. This reduced the noise level and softened and added color to the general office area.

2. Desk Painting. The gray-green metal standard desks were repainted to match the flocked colors of the panels and were covered with new laminated desk tops which gave a few square inches more of desk area.

*Systems furniture is a system of panels on which desks, shelves, files, lights, and other accessories can be hung. Interchangeable components make the "system" adjustable for height, arrangement, and job function.

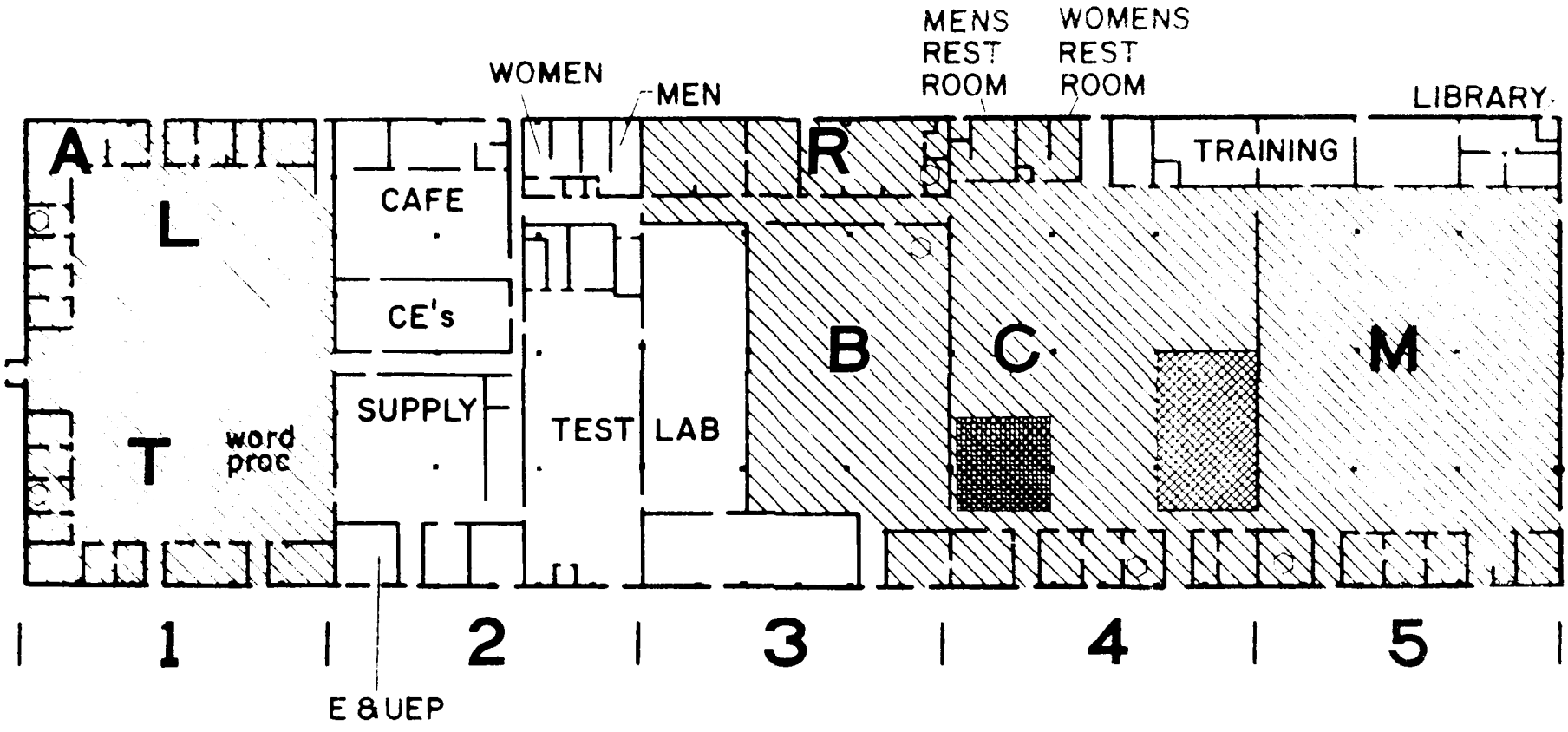




a. Typical open office areas from bank screened hallway at DSAC.

b. Typical individual office for programmer-level individual.

Figure 2. Typical DSAC office area environment at all workstation types and management levels (area part of initial survey, but not prototype or control group).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4 THE EXPERIMENT AND EVALUATION AT DSAC

Setting

The setting for the experiment was the DSAC office. The facility, which has about 48,000 sq ft of office area distributed on a single floor, is divided into four large open office bays, each containing 80 to 100 persons. Most offices were semi-enclosed by standard, gray-green government partitions. The desks were standard government issue, and the cabinets, bookcases, end tables, and file cabinets were all standard furnishings supplied by General Services Administration (GSA). Some managers had semi-private offices surrounding the central open office space. There were also conference rooms, a technical library, a computer room, and a snack bar. Several training classrooms were adjacent to the office areas and on both sides of the hallways. Figure 1 shows the general layout and configuration of the spaces.

Figure 2 shows the configuration of typical workstations and the surrounding environment of the large open office areas. The overhead lighting was standard fluorescent, the floors were tile, and there was almost no aesthetically supportive decor, such as plants or paintings.

Since renovation of certain areas had already been planned for the summer of 1980, this seemed a logical time for an experimental renovation. On the basis of the renovation proposal, an implementation committee was formed to develop design goals and conduct the research.

Approach

USA-CERL had already determined that one major problem with previous studies was their inability to draw design criteria-type implications from the results. Therefore, for this approach, survey and prototype data were gathered and analyzed using the following steps:

1. Orientation. This phase of the study involved the documentation of the present workstation modes layout. In addition, researchers coordinated with the management and the space planning committee to determine the goals, organizational structure, and need for job-related functional analysis of individuals at the workstations.

2. Data Collection. A survey was administered to the employees to determine their workstation needs.

3. Data Analysis. The survey data was analyzed. Summary statistics, tests of significance, and regressions were run on some or all portions of the data either by location within the facility or job function. The results were used to evaluate hypotheses for constructing a prototype test area.

4. Design of the Prototype Area. A prototype area was selected to receive new furniture. This area, which was located in a central portion of the office building, had 18 to 20 workstations. Control groups were selected from the same area of the office. Several tentative prototype area plans were developed, and one of these was selected as the prototype.

were determined; then programmers occupied prototype mock-up areas for 3 months and evaluated them. Extensive monitoring and interviews during the mock-up phase resulted in some modifications. The basic methodology of this study was the model used to analyze the DSAC workstations.

A recent publication[8] on the impact of computer automation on workstation design examines the impact of the visual display terminal (VDT) and keyboard on the variables associated with computer workstations. The study analyzes all factors having ergonomic relationships to workstation design decisions and then relates these relationships to workstations found in a modern office. The analysis reviews factors such as noise, lighting, glare, anthropometric variation, and comfort (heating, ventilating, and air conditioning). Fatigue is shown to be a negative indicator of productivity. This study is the most complete categorization of human factor variables available in relation to settings with computer terminals. However, it does not clearly recommend a specific design or layout that could be used to accommodate the needs of different job functions or floor space manipulations. The DSAC research used information from this study as background information.

It becomes apparent that one aspect of developing workstation design criteria that is missing in the literature is using job function to determine different types of workstation design needs and identifying how this information affects productivity. All the workstation design criteria for the DSAC study are affected by the high use of computer-related technology, and most jobs require much concentration. Therefore, employee needs for performing their tasks were evaluated constantly.

[8] A. Cakir, et al., Visual Display Terminals (John Wiley & Sons, 1980).

assumed that the results of this analysis would give insight into ways to achieve space economy, thereby reducing construction expenses.

Table 17 reveals some interesting interpretation possibilities. One notes that the strongest variables affecting the perception of "adequacy of space" are desk size and workstation flexibility. When entered into the regression equations, these variables account for 45 to 71 percent of the total variance in the models. Since the analysis was done for all job function groups, this finding should be relatively stable for most groups. This implies that the concept of "adequate space" does not generally refer to the room configuration, but instead is very locally related to desk size (most individuals noted adequate size in GSA-type desks), and to workstation flexibility (ability to accommodate different tasks).

A general interpretation of these results would first suggest that the two major variables appearing in most of the regressions are very stable and that most individuals are not as concerned with the size of their office as they are with workstation flexibility. Therefore, for the job functions, the perception of space as "adequate" is a very work-related variable. The concept of adequate privacy appears only in the regression model for supervisory management and functional analyst. Since people in the first function are responsible for personnel evaluation and consultation, it is not surprising that this variable would appear. For others who do computer-related analysis and design, the two major variables were desk size and workstation flexibility.

Table 18 shows the series of multiple regressions which use satisfaction with furniture as the dependent variable and which try to identify major components across job functions. This model accounts for a minimum of 44 percent of the total variance for each job category. It should also be noted that although there is some variation across job functions, the major components seem to be furniture comfort and pride in furniture. These two components consistently show up across most of the job function levels. Although the conform factor does not appear in the supervisory management group regressions, this may be related to the fact that management has different chairs than the rest of the occupants. These results imply that although there are different models which may account for the variance across job functions, the components of "furniture comfort" (probably relating to the chair comfort) and "pride in furniture" are the two most important variables within this group.

"Satisfaction with privacy at the workstation" was used as the dependent variable to construct multiple regression models (Table 19). In this case, multiple regression accounted for only 22 to 42 percent of the total variance. An inspection of the equations shows that two major factors seem to contribute most to the construction of the regression models: the "control over privacy" and "conversations in my room disturb" variables. Lack of control of privacy is the primary variable affecting the variance in the regression model.

In a private room, privacy can be controlled easily by shutting the door. In open office areas, or in office areas that are partitioned for easy access, control over privacy by design is more subtle. Control over privacy in an open office area can be handled through partial partitioning, full partitioning, or small "do not disturb" signs. However, because of the organizational structure of most teams at DSAC, control over privacy becomes more of a managerial variable. That is, team members who must work together require constant intercommunication. It may be possible that for certain types of job functions and office work environments, "control over privacy" will remain a problem variable for all conditions. In the IBM study, privacy control was handled by giving every computer-related job function a private office with a door that could be shut. This is an effective means of privacy control, but is not necessarily cost-effective.

Table 1

General Workstation Evaluation by Job Function

	Good Prof.* Image of Workstation		Adequately Flexible Workstation		Attractive Workstation		Pride in Workstation		Personalize Workstation	
	Agree	Disagree	Agree	Disagree	Agree	Disagree	Agree	Disagree	Yes	No
Management	6.3%**	91.7	20.9	50.0	6.3	87.6	22.9	60.4	58.4	20.8
Computer Prog.	3.1	80.6	34.7	50.0	2.1	89.7	15.8	47.4	55.1	24.5
Systems Analyst	6.8	87.5	20.3	59.5	4.1	83.8	16.3	60.8	54.1	33.8
Functional Analyst	5.6	80.6	25.7	51.4	0.0	88.9	25.0	47.2	47.2	38.9
Clerk	22.2	66.6	29.6	33.3	7.4	66.6	48.1	29.6	70.3	22.2
Secretary	13.4	40.0	46.7	33.3	13.4	53.3	53.4	20.0	80.0	13.4
	N=298		N-298		N-298		N=298		N=298	

*Respondents who were neutral are not included.

**Numbers are percentages; i.e., 6.3 percent of management respondents think their workstation has a good professional image.

Inspection of this table by job function reveals that most employees do not think that their workstation has a good professional image, irrespective of job. Generally more than half of the occupants do not think that their workstation is flexible enough to meet their needs, with the exception of the secretary and clerical functions. Almost all thought their workstations unattractive. The four primary groups do not have a great deal of pride in their own workstations, yet most occupants seem to indicate they do make an effort to personalize the work area they are in, indicating there is some degree of territorial pride in the space they occupy, but this attitude is not reflected in their evaluation of furnishings.

Table 2

Physical Workstation Parameters by Job Function

	Satisfaction* With Furniture		Size of Desk Adequate		Workstation Area Adequate		Storage Adequate	
	Agree	Disagree	Agree	Disagree	Agree	Disagree	Agree	Disagree
Management	12.5%	79.2	52.1	39.6	50.0	55.4	39.6	54.1
Computer Prog.	11.3	68.0	57.2	27.0	42.9	43.9	31.6	52.8
Systems Analyst	11.1	70.8	54.0	31.1	50.0	35.2	28.4	59.5
Functional Analyst	2.8	75.0	44.0	44.5	47.2	33.3	25.0	55.6
Clerk	11.5	53.9	74.0	18.5	59.2	29.6	33.3	66.6
Secretary	13.4	73.3	73.4	13.3	60.0	13.4	53.4	20.0
		N=298		N = 298		N = 298		N = 298

*Repondents who were neutral were not included.

This table looks at job function in terms of physical adequacy for basic requirements. Almost all job groups are highly dissatisfied with their furniture; however, most also indicate the size of the desk to be adequate for their tasks. However, in terms of storage space and adequate area to accomplish the job function, differences begin to appear. Programmers are the most dissatisfied with the area around their workstations, but not quite as dissatisfied as system and functional analysts with the storage adequacy in and around their desks. These three job functions tend to also hold the most conferences per week at their workstations (see Table 5), so one might assume that both storage and space for these conferences might be the problems.

Table 3

Disturbances and Privacy by Job Function
(Percent of Respondents Indicating a Problem)

	Conversations Disturb	Noise Through Wall Disturbs	People Come In Disturb	Telephones Disturb	Visual Distractions Disturb	No Control Over Privacy
Management	68.8%	93.8	60.5	29.8	31.3	52.1
Computer Prog.	79.6	89.5	61.9	37.8	30.6	91.9
Systems Analyst	89.2	95.8	63.0	45.2	31.2	89.2
Functional Analyst	75.0	77.8	47.6	38.9	27.8	86.1
Clerk	44.4	62.9	37.0	22.2	18.5	77.8
Secretary	26.6	73.3	33.3	21.4	13.3	60.0
	N = 298	N = 298	N = 298	N = 298	N = 298	N = 298

The tabulation above indicates that privacy is a major problem, except perhaps for secretary and clerk levels. Because the self-rated need for concentration is lower in these jobs (last column), the need for privacy may not be as great. However, the perceived lack of control over privacy (second to last column) still shows a rather high irritation level. The rating of better privacy control for managers can be attributed to private offices with doors. There seem to be three components causing irritation with privacy across most job functions: conversations, noise through walls, and people entering the workstation, while phones and visual distractions do not appear to be a problem across any particular job function. Conversations in the room disturb everyone except clerks and secretaries. Noise through walls disturbs everyone equally. People coming into the workstation irritate managers, programmers, and systems analysts to a greater extent than anyone else. Much of this general dissatisfaction with all components of privacy can be attributed to the open bullpen-like office areas existing at DSAC. The results suggest the need for some sort of workstation partitioning between offices and some better acoustic control.

Table 4

Room Occupancy in Room With Respondent

	No. of People in Room With Respondent				
	1	2-4	5-7	8-10	N
Management	42.6%	4.2	25.6	9.7	47
Computer Prog.	0.0	8.1	61.2	13.3	98
Systems Analyst	0.0	12.3	56.1	15.0	73
Functional Analyst	7.8	2.8	30.7	52.8	36
Clerk	25.9	7.4	14.8	7.2	27
Secretary	46.7	20.0	6.7	18.9	15

N = 296

The table indicates that the rooms with an occupancy of 5 to 7 individuals fall within the three computer-related groups of programmer, systems analyst, and functional analyst. In the existing arrangement at DSAC, this is not surprising, as most open office areas with some sort of team structure usually fall into this size. However, as higher room occupancy tends to decrease privacy-related variables, some compromise should be made to reduce "perceived" room occupancy through the use of partitions, screens, or other methods.

Table 5

Conferences/Week by Job Function*

	0	1-3	4-6	7-10	10+
Management	0.0	28.3	30.2	[illegible]	22.6
Computer Prog.	12.3	72.2	12.4	2.1	1.0
Systems Analyst	2.9	65.2	23.2	7.2	1.4
Functional Analyst	0.0	88.9	5.6	2.8	2.8
Clerk	33.3	66.7	0.0	0.0	0.0
Secretary	44.4	50.0	5.6	0.0	0.0

N = 300

*Note that when asked, "Where do these conferences occur," more than 50 percent for every category indicated at the desk, except for managers, who indicated 37 percent in their offices and 51 percent at someone else's desk.

The number of conferences per week is a secondary indicator of the space required to accommodate these needs, and the business-related activity associated with them in terms of noise, intrusion of privacy, etc. Inspection of the table shows that, although management has the greatest overall number of conferences, the computer-related groups tend to have the most intensity, with up to three conferences per week. The conferences are generally held at the respondent's desk except for the managers. From interviews, it was determined that most conferences are short-duration, and on a person-to-person basis for programmers and analysts.

Table 6

File Adequacy by Job Function

	Inadequate	Neutral	Adequate
Management	36.6%	17.3	46.2
Computer Prog.	45.1	25.3	29.7
Systems Analyst	44.6	20.0	35.4
Functional Analyst	52.8	19.5	27.8
Clerk	51.8	11.2	37.0
Secretary	22.2	33.3	44.5

N = 289

Table 7

Dead File Drawers by Job Function

	1-2	3-6	7-10
Management	32.0%	46.0	20.0
Computer Prog.	39.5	36.8	21.1
Systems Analyst	29.8	54.4	10.5
Functional Analyst	45.5	30.3	21.2
Clerk	28.0	52.0	12.0
Secretary	17.6	76.5	5.9

N = 258

These tables are interesting in that they suggest other than a design solution to a problem. The general tendency seems to show that the filing space is somewhat inadequate across most groups, except for the clerks. The functional analyst, systems analyst, and programmer all suggest inadequate space, yet these are the same job groups which indicated very large percentages of dead file drawers "under their personal control." An inspection of the dead-file drawer table reveals a strong need for a house-cleaning by job function, rather than an addition of more file space. Even discounting the fact that part of the responses may be related to the larger size of computer listings, the most cost-effective action is internal, not additional procurement of furniture to solve this problem.

Table 8

Number of Working Desk Drawers*
Required for an "Adequate" Rating

	1 Drawer	2 Drawer	2+ Drawers
Management	48.3%	13.8	37.9
Computer Programmer	33.3	25.0	41.7
Systems Analyst	39.3	14.3	46.4
Functional Analyst	45.5	9.1	45.5
Clerk	66.7	16.7	16.7
Secretary	55.6	22.2	22.2

*Not counting desk pencil drawer.

Table 9

Number of File Cabinet Drawers
Required for an "Adequate" Rating

	0 Drawers	1-2 Drawers	3 Drawers*	N
Management	25.9%	26.0	40.7	27
Computer Prog.	23.3	40.0	36.7	30
System Analyst	17.4	56.6	21.7	28
Functional Analyst	0.0	30.0	70.0	10
Clerk	0.0	45.5	54.5	12
Secretary	0.0	37.5	62.5	8

*Since common procurement practice only allows two- and four-drawer cabinets, three- and four-drawer cabinets are combined here.

The combination of Table 8 and Table 9 suggests the distribution of required filing space to generate a rating of "adequate" on the "adequacy of filing space" question. Those respondents who, by job function, rated their filing space "adequate" were analyzed in sub-groups to determine the best distribution of drawers in desks and drawers in file cabinets. Although the number of respondents in each category is small (only those with "adequate" rating), the frequencies give some idea of the general distribution required to satisfy filing storage needs. It should be noted that some percentage of these frequencies will be made up of computer listings, and therefore may require further adjustment if a Wright line file, or equivalent, is used.

Table 10

Chalkboard Useful

	No	Neutral	Yes
Management	22.6%	13.2	64.1
Computer Programmer	63.5	20.4	15.6
Systems Analyst	52.2	26.1	21.7
Functional Analyst	58.3	30.6	11.1
Clerk	92.3	3.8	3.8
Secretary	83.4	5.6	11.1

N = 298

Table 11

Tackboard for Graphics Useful

	No	Neutral	Yes
Management	30.1%	37.2	22.6
Computer Programmer	54.7	28.9	16.5
Systems Analyst	46.0	39.1	14.4
Functional Analyst	61.1	27.8	11.2
Clerk	79.1	12.5	8.3
Secretary	66.7	10.2	22.3

N = 297

In terms of accessories at the workstation, it is very interesting to note that the only group really finding a need for a chalkboard is the managers. The computer-related groups rather strongly indicate a neutral or negative desire to have one. The second question was intended to determine if tackboards were useful to the design of the workstation. Again, only the managerial level showed any preference at all for this amenity, and even then a moderate interest.

Table 12

Computer Terminal Related Activities by Job Function

	A. Operate a Terminal		B. Share a Terminal		C. Hours on Terminal				
	Yes	No	Yes	No	Less 1 hr	1-2	2-3	3-5	5+
Management	18.9%	81.1	83.3%	16.7	100.0%	0.0	0.0	0.0	0.0
Computer Programmer	80.2	19.8	98.7	1.3	50.6	34.2	8.9	3.8	2.5
Systems Analyst	68.1	31.9	100.0	0.0	65.2	12.4	17.4	0.0	0.0
Functional Analyst	47.2	52.8	100.0	0.0	70.6	11.8	11.8	0.0	5.9
Clerk	65.4	34.6	88.9	11.1	22.2	27.8	5.6	*33.3	*11.1
Secretary	61.1	38.9	81.8	18.2	9.1	18.2	18.2	*45.5	*9.1
	N=298		N=183			N=182			

*Some portion of this group is involved in word processing.

Since the terminal and its daily use represent the most clear interface with the computer for most workstation occupants, the above table represents a summary of that activity. Most job levels below manager operate a terminal, with programmers, systems analysts, and functional analysts ranked in terms of declining usage. Clerks and secretaries (DSAC has central terminal access to word processing) show high usage. However, almost all DSAC workers share a terminal of some sort (except for managers who seem to share one as required for their job). In terms of hours per day, the heaviest users are the programmers, followed closely by the system and the functional analysts. The high terminal usage by clerks and secretaries is attributed to the nature of their job and the impact of word processing on the office.

Table 13

Linear Inches of Notebooks (Respondents Indicating Present Needs in Terms of Linear Inches of Shelf Space Presently Used)

	Number of [illegible]						No. Inches Satisfying 50% of Group Requirement	No. Inches to satisfy 75% of Group
	0	1-12	13-24	25-36	37-48	48+		
Management	6.0	60.4	14.5	2.9	5.5	7.4	25"	25"
Computer Programmer	3.0	78.1	9.4	4.2	2.1	1.0	25"	25"
Systems Analyst	2.9	73.5	14.7	2.9	2.9	2.9	25"	25"
Functional Analyst	14.3	65.7	2.4	2.9	2.9	11.4	25"	25"
Clerk	23.1	65.4	0.0	0.0	3.8	7.7	25"	25"
Secretary	11.1	83.3	5.6	0.0	0.0	0.0	25"	25"

N = 296 observations

Table 14

No. of 1- to 3-In. Documents Which Respondents Presently Have

	0	1-12	13-24	25-36	37-48	48+	Assuming Ave. 1 1/2"/Doc, Each Job Group Requires: The Following No. of Inches on a Shelf: To Satisfy 50% of Pop. Population	To Satisfy Additional 75% of Population
Management	3.8	34.0	17.0	17.0	11.3	17.0	36"	54"
Computer Prog.	21.0	68.0	17.5	3.1	3.1	6.2	18"	18"
Systems Analyst	2.9	55.1	24.6	8.7	0.0	8.7	18"	36"
Functional Analyst	0.0	63.9	8.3	11.1	0.0	16.7	18"	36"
Clerk	28.0	44.0	16.0	0.0	0.0	12.0	18"	18"
Secretary	23.5	52.9	17.6	0.0	0.0	5.9	18"	18"

N = 297 observations

Number of 3-In. Documents

	[illegible]	Number of 3-In. Documents					[illegible]	No. of Inches to Satisfy 50% of Population	[illegible]
		[illegible]	[illegible]	9-16	17-24	[illegible]			
Managerial	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]		4 doc.	[illegible]
Computer Programmer	[illegible]	28.9	16.5	3.1	[illegible]	1.0		4 doc.	0	[illegible]
Systems Analyst	36.5	30.9	5.5	14.7	2.9	9.4	[illegible]	8 doc.	12"	[illegible]
Functional Analyst	45.0	25.0	11.4	5.7	0.0	5.7	0	4 doc.	0	[illegible]
Clerk	57.0	34.5	3.8	0.0	3.8	7.7	0	4 doc.	0	[illegible]
Secretary	53.3	37.5	0.0	0.0	6.3	0.0	0	4 doc.	0	[illegible]

N = 295

Table 16

Summary Shelf Recommendations

Summary Table	From Table 13 Inches		From Table 14 1-3 In. doc.		From Table 15 Over 3-In. Doc.		No. of Total Inches of Shelf Space to Satisfy Requirement For Each Job Function: 50% of Population Satisfied	75% of Population Satisfied
Managerial	25"	25"	36"	54"	0"	12"	61"	91"
Computer Prog.	25"	25"	18"	18"	0"	12"	43"	55"
Systems Analyst	25"	25"	18"	36"	12"	36"	55"	97"
Functional Analyst	25"	25"	18"	36"	0"	12"	43"	73"
Clerk	25"	25"	18"	18"	0"	12"	43"	55"
Secretary	25"	25"	18"	18"	0"	12"	43"	55"

The number of documents on shelves and tables in and around the workstation will determine the amount of on-shelf storage required. Tables 13 through 15 indicate the responses on the questionnaire and the summary Table 16 indicates the composite requirements for job function for these categories. One must note in interpreting the data that computer listings are included in the tabulation. Although this tabulation focuses on total "inches" of documents, it does not indicate area. Since listings are generally twice ordinary paper size and must lie flat, an adjustment factor should be included in a 50 per cent listing makeup per workstation. Also, it was decided to focus on accommodation of 75 percent of the workstation requirements under the assumption that the remaining 25 percent would require special needs, be temporary hires, or short term Government contractors working on DSX [illegible].

Table 17

Job Function Regression Models for Satisfaction With Area of Workstation Space

	R^2	N	Constant	Satisfaction with Furniture Q10	Desk Size Q16	Storage Space Q18	Work-station Flexibility Q19	Privacy Adequacy Q21
Supervisor Management	.53	53	-1.13	___	___	.263	.485	.373
Computer Programmer	.50	95	.352	___	.299	.225	.332	___
Systems Analyst	.49	67	-.094	___	.302	___	.615	___
Functional Analyst	.45	35	-.140	___	.383	___	___	.446
Clerk	.52	27	-.108	___	.312	___	.561	___
Secretary	.71	17	.114	___	1.05	___	___	___

NOTE: R = multiple correlation coefficient; $100R^2$ = percent of variation in the dependent variable (satisfaction with area of workstation space) explained by the equation. Ex.: For systems analyst, the equation:

Satisfaction with area = -.094 + .302 (adequacy of desk size) + .615 (flexibility of workstation) explains 49 percent of the variation in responses to the satisfaction with area question.

[illegible] with Furniture
[illegible] of Personnel

[illegible] - 2.6[illegible] + .[illegible] Colorful + .61 Proud)

Table 19

Job Function Regression Models for Satisfaction With Privacy

				Q097	Q098	Q099	Q100	Q101	Q102	Q103	Q105
[illegible]	N	R^2	Constant	Conversation Disturbs	Hear Noise	People Keep Coming In	Telephone	Control Privacy	Visual Disturbs	Concentration	No. People Seen While Sitting
[illegible]	[illegible]	.38	3.17	-.37	---	---	---	.41	---	---	---
[illegible]	[illegible]	.41	3.[illegible]	---	---	-.71	---	.43	---	---	---
Systems Analyst	[illegible]	.43	4.73	-.47	-.61	---	---	.39	-.29	---	---
[illegible]	[illegible]	.22	5.15	-.51	---	---	---	---	---	---	---
[illegible]	27	.36	2.49	---	---	-.46	---	.45	---	---	---
[illegible]	17	--	---	---	---	---	---	---	---	---	---

(Example: Systems Analyst Model - SAT PRIVACY = 4.73 - .47 Conv. Disturb [illegible] - .61 Hear Noise + .39 Control - .29 (Visual Distract)

between the "before" and "after" conditions for the CONTROL groups by the letter "c." Using these profiles, the nature of the differences caused by the extensive renovation in the prototype area can be determined quickly.

The first set of profiles (Figure 11) concerning furniture in the workstation shows the following: (1) the control groups form a rather narrow band, (2) the pre-renovation prototype generally falls within that band, and (3) there are several major, statistically significant shifts toward improvement in the post-renovation prototype. The renovation significantly improved ratings of comfort, variety, modernness, colorfulness, newness, pride, and overall satisfaction with furniture. Since the same furniture (refinished and reupholstered) was used in the post-renovation prototype, it is not surprising to find out that there is no change in ratings of damage, sturdiness, and quality.

There were also some significant changes in the control group ratings (represented by the letter "c") which were not expected. During the 6-month efficacy part of the study, the management added more Wrightline storage units to the control group area. About 50 percent of the control group personnel received these files, and this may have caused significant changes in responses in the "modern," "new," "pride," "sturdy," and "quality" categories. (However, the new files in the control group did not cause as large a shift as the total renovation of the prototype area.)

Inspection of the profile ratings for workstations in general (Figure 13) shows that the shifts in satisfaction are not as great as for those with furniture; however, some are significant. There is a statistically significant improvement on scales relating to size of desk, storage space, professional image, attractiveness, ease of cleaning, and pride in workstation. The change in the rating for size of desk is particularly interesting, since the size of the desk was actually very small (1 in. in length and 1 in. in width); however, storage carrels for notebooks and computer listings were added on the desk surface, which is now laminated.

It is also interesting to note that although the new layout for the prototype area allotted less floor area per person than before, there was no change in the rating of adequacy of space. (In the pre-renovation condition, there was 115 sq ft per person, and in the post-renovation only 105 sq ft per person; control groups did not change.) This implies that the new design is making better use of the floor space. Finally it is interesting to note that there was no significant shift in preference for someone else's workstation between prototype and control groups. This may be because there was no real change in furniture, but rather only a refurbishing of the same furniture; therefore, the people may have perceived that the furniture was still the same and that improvements were only reflected over certain other scales.

[illegible] problem with changes in privacy in the workstation. One of the [illegible] employees who filled out the pre-renovation survey was the [illegible] of privacy [illegible] adequacy; however, the area picked for the prototype renovation was characterized by a management need for continuous close [illegible] and inter-team consulting. This implies that privacy must be compromised because of the way the team performs its duties (i.e., no design can [illegible] satisfaction with privacy).

PRIVACY IN WORK STATION

[illegible]

[illegible]. Conversations in my room disturb my ability to concentrate. ___ : ___ : ___ : ___ : ___

[illegible]. I can hear noise thru the walls of my office. ___ : ___ : ___ : ___ : ___

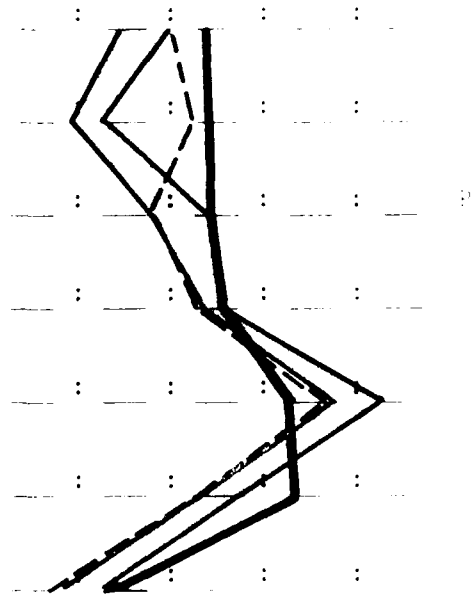
80. People keep coming into my room and disturbing me. ___ : ___ : ___ : ___ : ___

[illegible]. The telephones in my room are a noise irritant. ___ : ___ : ___ : ___ : ___

[illegible]. I have a high degree of control over my privacy in my room. ___ : ___ : ___ : ___ : ___

[illegible]. I have many visual distractions in my office which are disturbing. ___ : ___ : ___ : ___ : ___

[illegible]. My job requires a high degree of concentration. ___ : ___ : ___ : ___ : ___



[illegible]. The number of people in my room is _____.

[illegible]. Number of people I can see while sitting at my desk is _____.

[illegible]. Changes in privacy evaluations. This part [illegible] in privacy evaluations by occupants in the prototype [illegible] groups for the before and after renovation [illegible].

[illegible] to the physical space in the room you and your office [illegible]. [illegible] aspects of your work station layout may affect your [illegible]. [illegible] indicate the degree to which you agree or disagree [illegible] statements.

16. The size of my desk surface is adequate for my tasks.
17. The area my space occupies is adequate for my tasks.
18. I have enough storage space in and around my desk.
19. I find my work station flexible enough to meet changing requirements.
20. I think my work station presents a professional image.
21. The privacy I now have is adequate for my tasks.
22. My work station is an attractive arrangement.
23. My work station is easy to keep clean.
24. I do bring items from home to personalize my work area.
25. There are no safety hazards associated with my work station.
26. I associate a personal sense of pride with my work station.
27. Someone else has a work station I would prefer rather than mine.

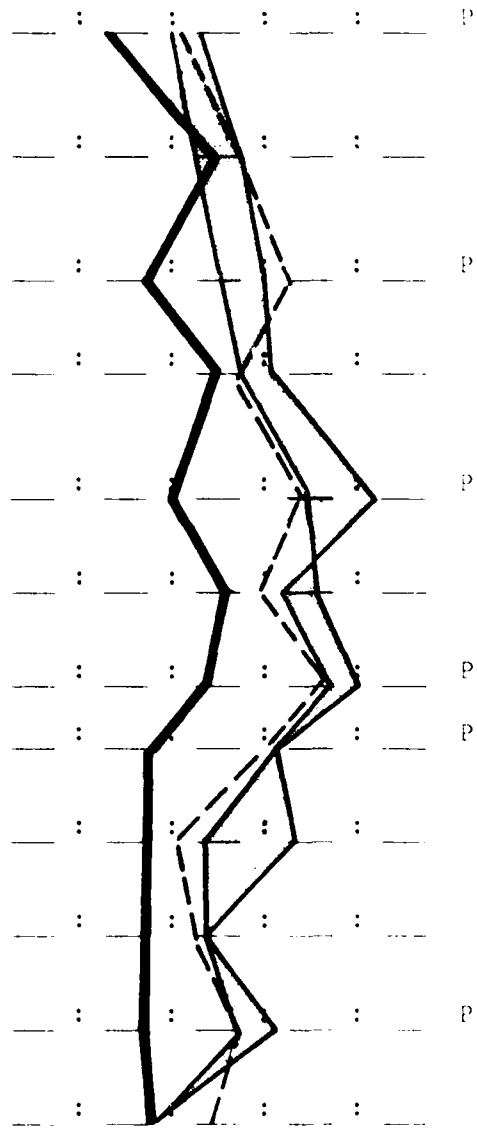


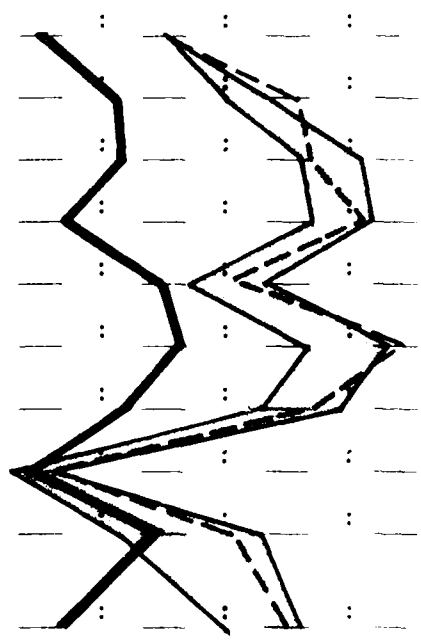
Figure 12. Changes in workstation evaluations. This profile shows the changes in occupant perceptions of their own workstation area for the prototype and control groups before and after renovation.

FURNITURE

Card 1
Col. 1-3
Quest. No.

[illegible] the furniture in your work station [illegible] the furniture evaluate for a number of individual items [illegible] on a map. Please indicate your [illegible] statements.

1.	My furniture is comfortable	___ :	___ :	___ :	___ :	___	P
2.	I have a wide variety of furniture	___ :	___ :	___ :	___ :	___	P
3.	My furniture is modern and stylish	___ :	___ :	___ :	___ :	___	PC
4.	My furniture is colorful	___ :	___ :	___ :	___ :	___	P
5.	My furniture is easy to damage	___ :	___ :	___ :	___ :	___	
6.	My furniture is new	___ :	___ :	___ :	___ :	___	PC
7.	I am proud of my furniture	___ :	___ :	___ :	___ :	___	PC
8.	My furniture is sturdy	___ :	___ :	___ :	___ :	___	C
9.	My furniture is high quality	___ :	___ :	___ :	___ :	___	C
10.	I am satisfied with the furniture in my work station	___ :	___ :	___ :	___ :	___	PC



LEGEND: In order to read the scales, the following codes are used:

HEAVY BLACK LINE.....Prototype area after 4 mo. occupancy
HEAVY DOTTED LINE....Prototype area before renovation began
LEFT LIGHT LINE.....Control group before renovation
RIGHT LIGHT LINE.....Control group after prototype renovation
SHADED AREA.....Range of movement for Control before and after
DARK LETTER "P".....Indicate significant difference between prototype before and after renovation
DARK LETTER "C".....Indicate significant difference between Control before and after renovation

Figure 11. Changes in furniture evaluations. This set of profiles shows the shift in respondents' opinions of furniture adequacy for the prototype and control groups before and after renovation.

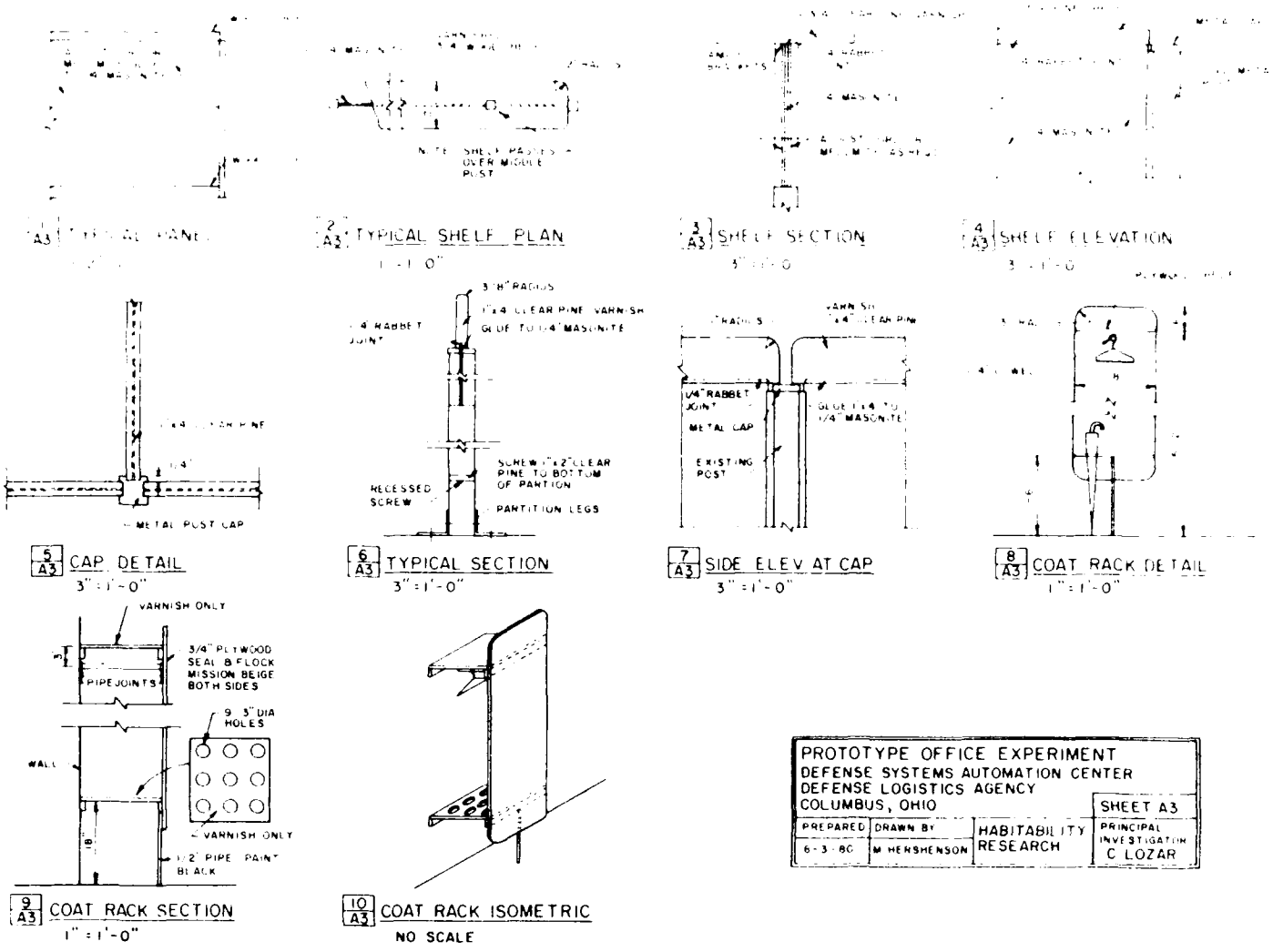
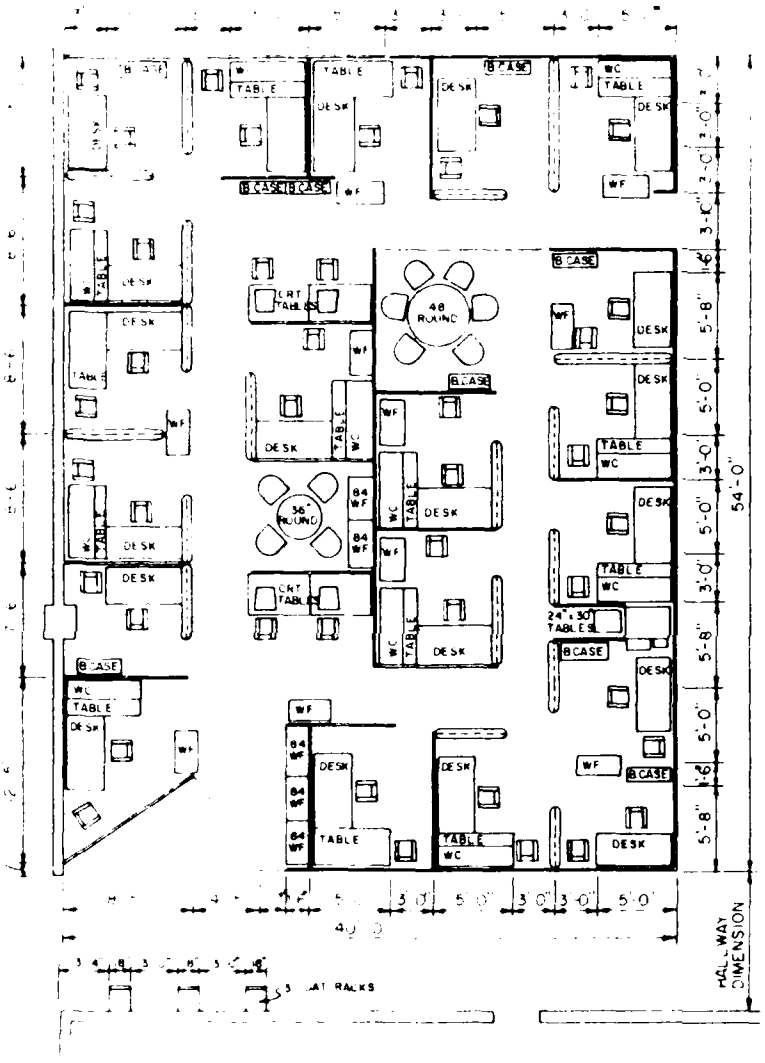


Figure 10. (Cont'd).



PRODUCT	
WRIGHT LINE FILE CABINET (58") WRIGHT LINE DOCUMENTATION ORGANIZERS	WRIGHT LINE, INC (A UNIT OF BARRY WRIGHT) 160 GOLD STAR BLVD WORCHESTER, MASS 01606
EXISTING DESKS EXISTING TABLES (34"x60") EXISTING BOOKSHELVES EXISTING WRIGHT FILES (84") EXISTING CRT TABLES EXISTING TABLES (24"x36")	U S GOVERNMENT
ROUND TABLES 36" (FT 108) ROUND TABLES 48" (FT 110) VP FINISH, WHITE CAV VENEER (OK)	HERMAN MILLER, INC 140 W McKINLEY ST ZEELAND, MICH 48464
REPAINT TABLES DESKS FILES	GSA CONTRACT #
REFURNISH CHAIRS	GSA CONTRACT #

PROTOTYPE OFFICE EXPERIMENT DEFENSE SYSTEMS AUTOMATION CENTER DEFENSE LOGISTICS AGENCY COLUMBUS, OHIO			SHEET A2
PREPARED	DRAWN BY	HABITABILITY RESEARCH	PRINCIPAL INVESTIGATOR
6-3-80	M HERSHENSON		C LOZAR

Figure 10. (Cont'd).

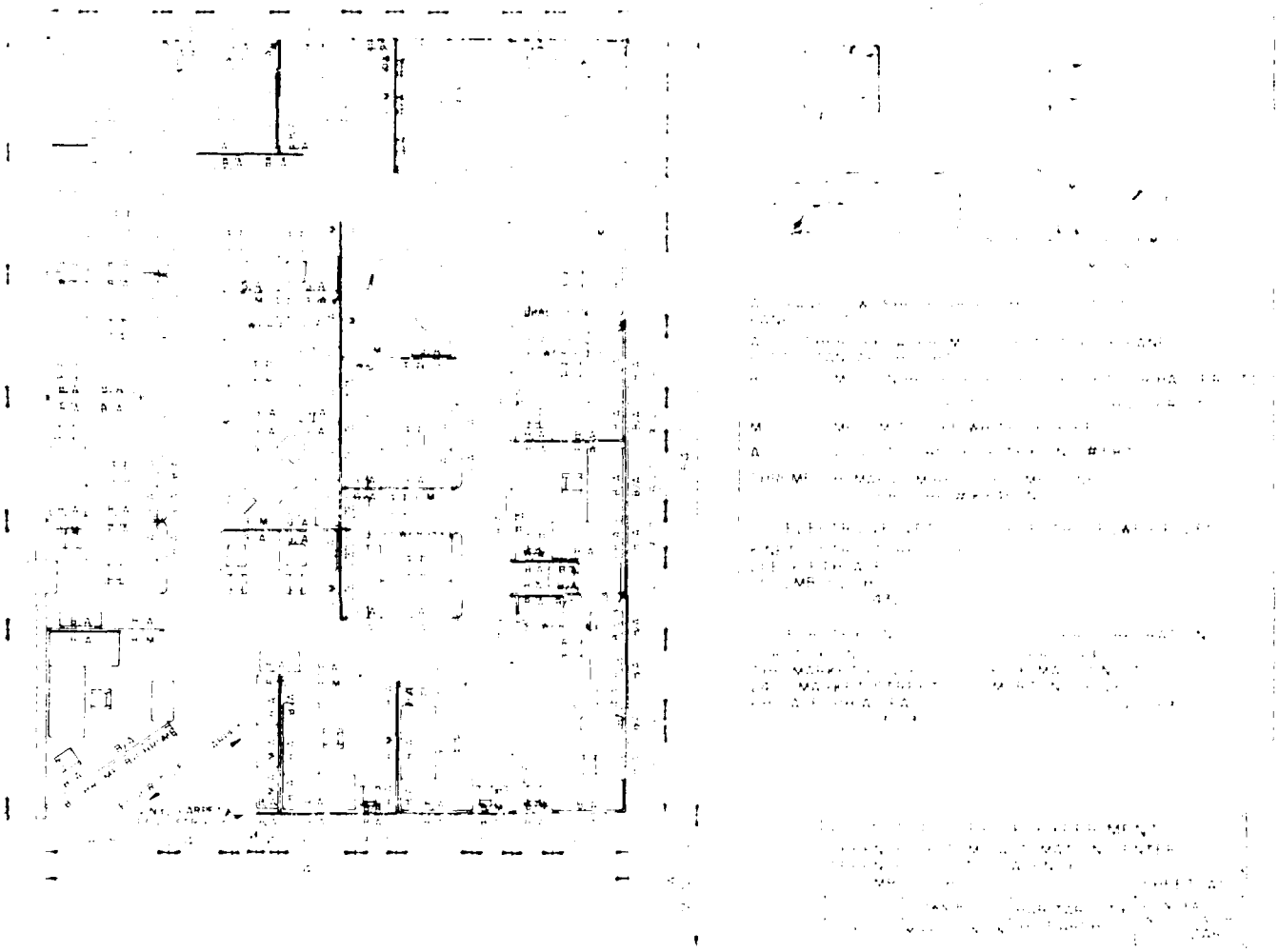
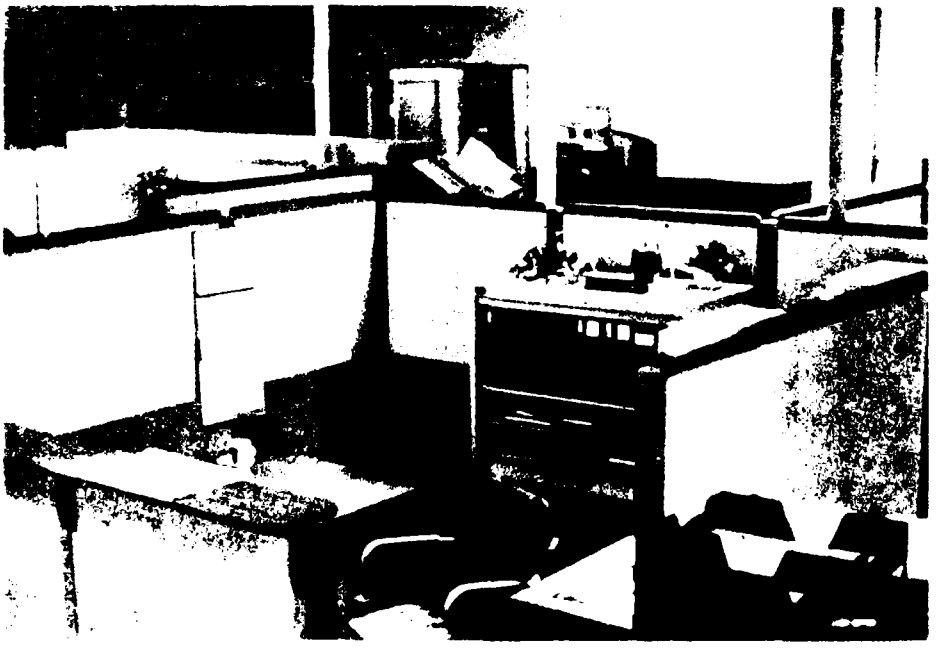


Figure [illegible]. Selected test wall details. (These three sheets [illegible] detailed drawings prepared for the construction of the prototypical test area. They are a further development of Figure 7 and were implemented as shown.)

[illegible]. Desk area for the leader and programmer level in prototype.

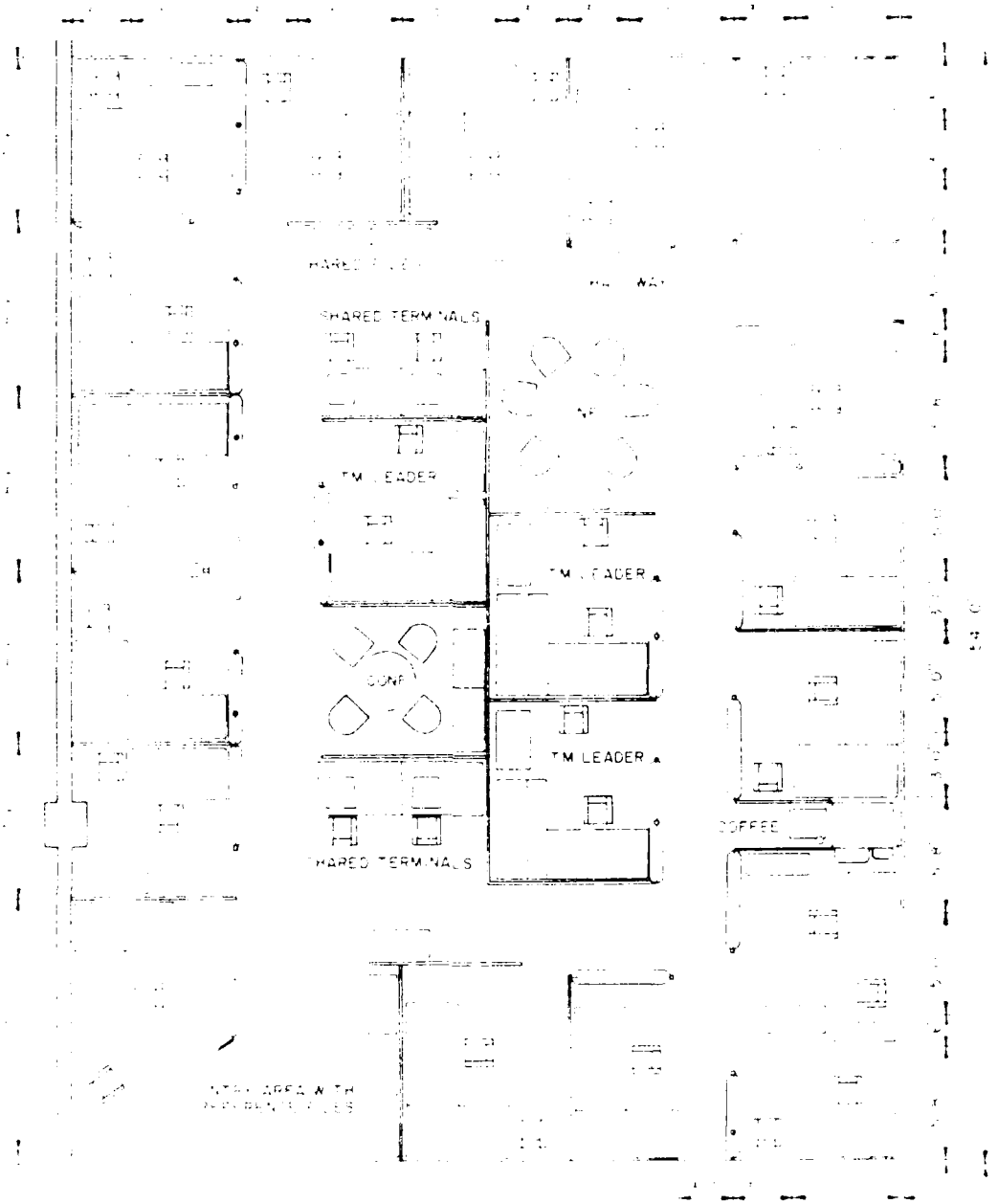


[illegible] area for the other [illegible] at partitioning.

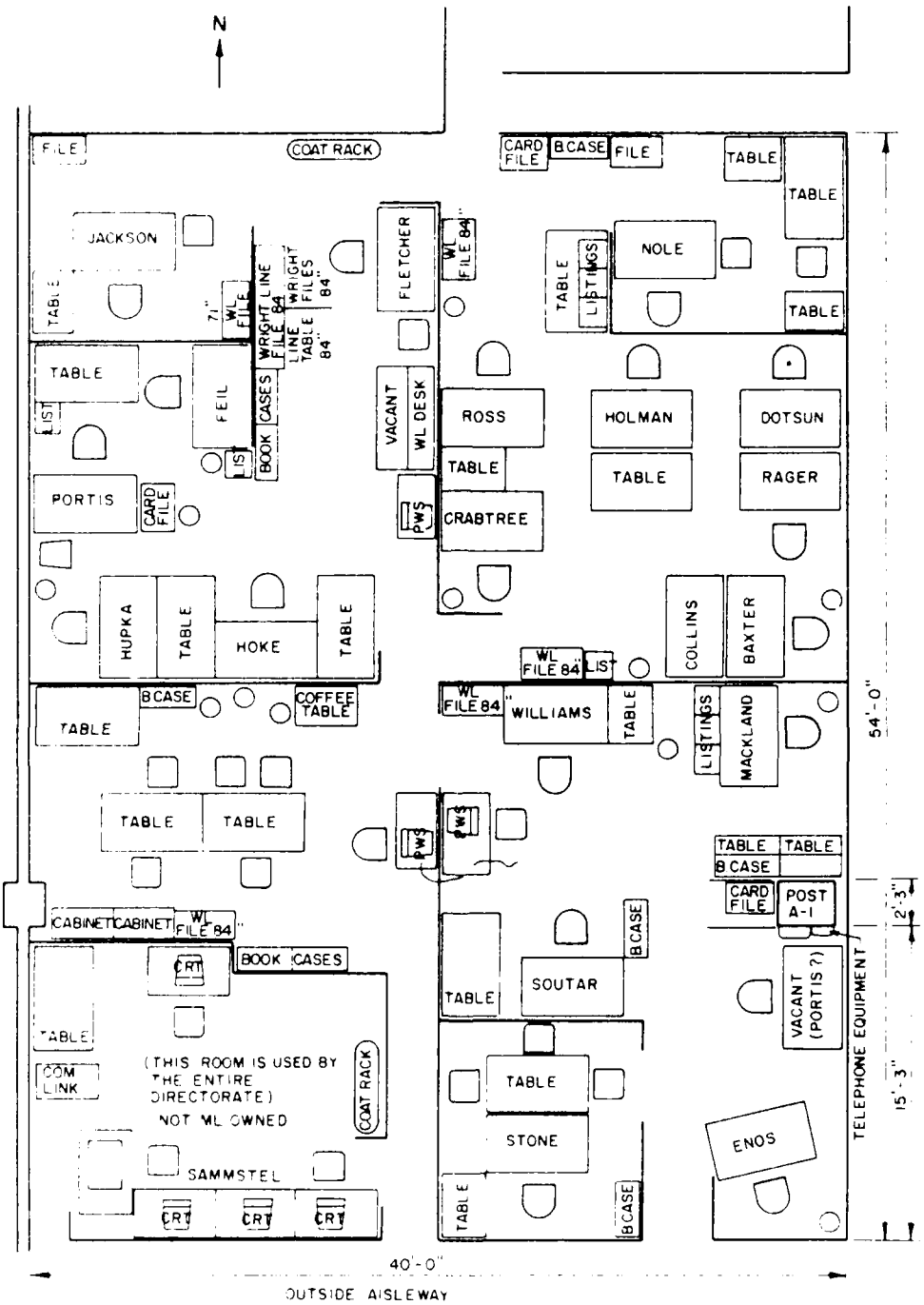
Figure 9. (Cont'd).

[illegible] prototype office area showing new partitions and shared [illegible] area.

[illegible] prototype office area after installation of new layout and furnishings.

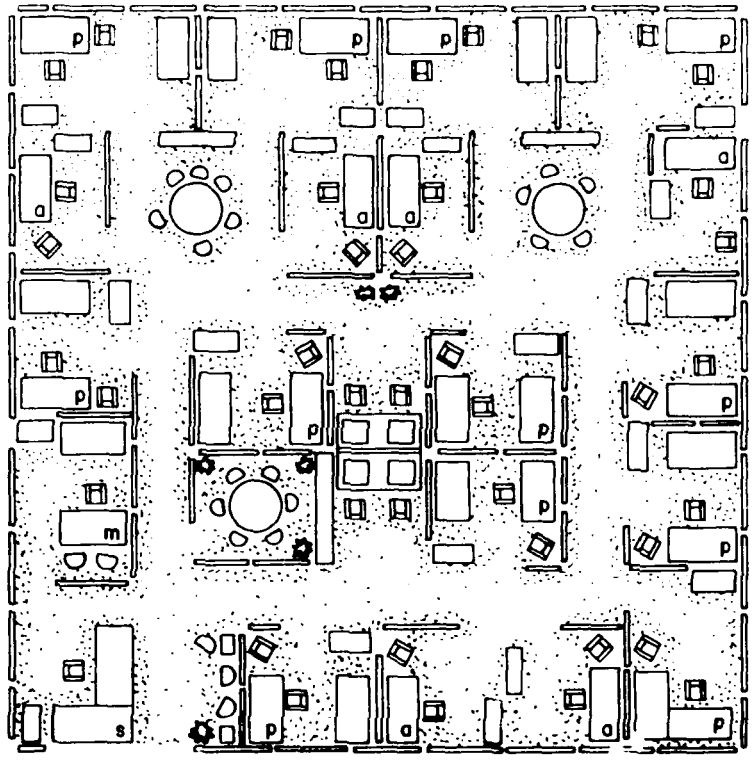

SHARED TERMINALS
TM LEADER
TM LEADER
CONF
TM LEADER
COFFEE
SHARED TERMINALS

[illegible] (Continued).



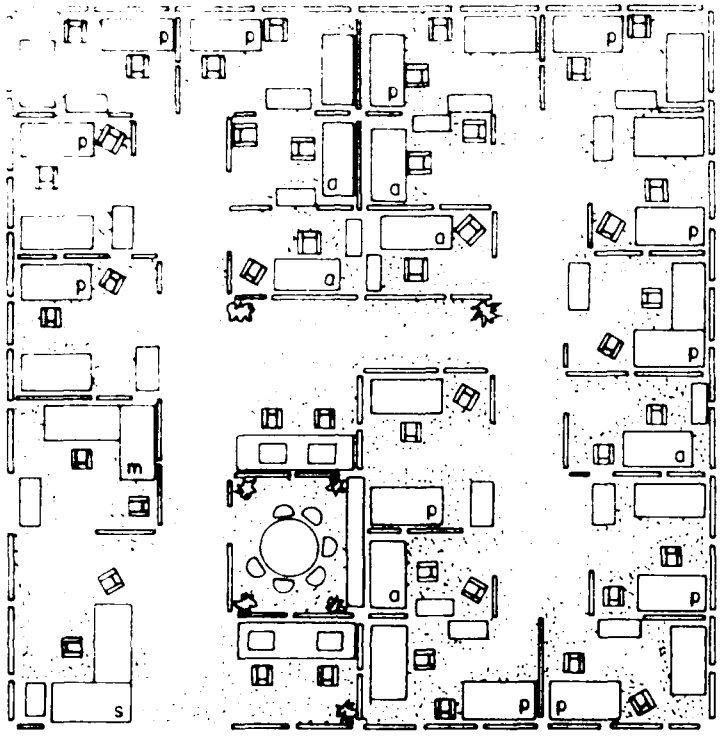
a. Prototype area before renovation.

Figure 8. Proposed layout for prototype area.

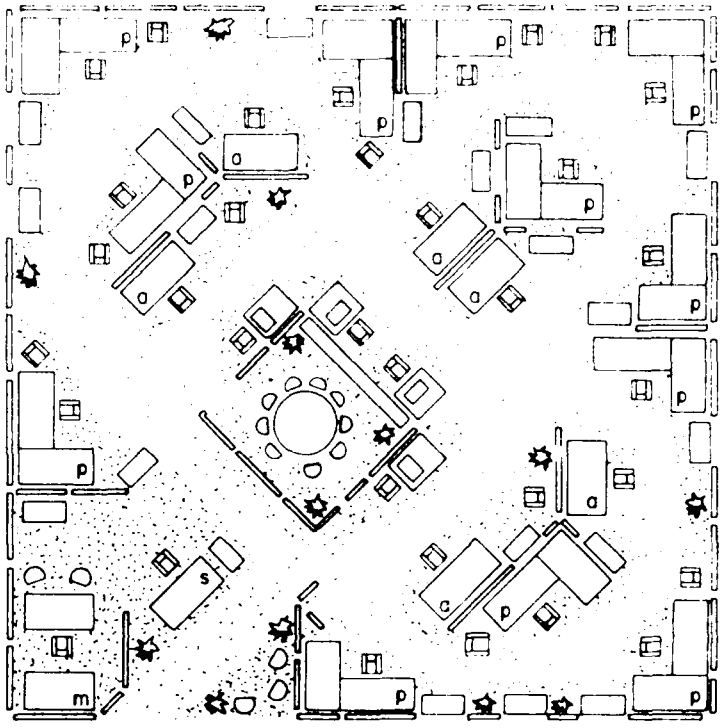


PLAN 3: This partially rectilinear plan has three dispersed areas for team space with a central area for project leaders. The shared terminals are at the outer boundaries of the circulation space.

Figure 7. (Cont'd).



1 PLAN 1: this plan has the highest degree of privacy and is the most rectilinear. It has one team leader core on the perimeter, and a low conference capacity.



2 PLAN 2: This plan is more open than the first with a conference area for the core. There is a lower degree of privacy, but more allowance for dynamic group interaction.

Figure 7. Workstation alternative designs. (These plans represent the alternatives evaluated by the researchers and the occupants to arrive at a final configuration. They are presented here to demonstrate that the final selection of a layout involved both the evaluation of the data from the survey questionnaire and the iterative evaluation of occupants involved in the process of designing their own office area to best assure productivity needs.

7 DESIGN AND EVALUATION OF PROTOTYPE AREA

Design Layout

A series of possible workstation arrangements was designed based on the survey results. The designs would be used to construct a general prototype area for 18 people. This area would then be rated and the results compared to those of a control group.

Figure 7 represents the designs that were drawn up to solve the problems identified during the initial survey. The workstations are arranged by job function (keeping in mind that private offices were not part of the branch selected for renovation) and the final layout determined from a match with the team functional requirements. Actions taken to renovate the furnishings were discussed in Chapter 5.

The design hypothesis was that these renovations would improve overall satisfaction with workstations and furnishings and perhaps improve overall productivity. If the improvements were successful, the changes could be the basis for renovating the entire DSAC floor area. There were several other solutions which might have had the same positive effects (e.g., systems furniture, all private offices, new standard furniture, etc.), but they were not part of the overall experimental design for this study.

The prototype area had already been selected by the management. The 18 people in this area were interviewed to determine their needs within their branch. Figure 8 shows the prototype area before renovation. By interfacing the proposed workstations shown in Figure 7 with their needs, the designer produced an approved layout (see Figure 8).

Evaluation Results of the Prototype Experiment

Figure 9 shows photographs of the completed prototype renovation. Figures 10a, b, and c contain the working details on which the renovation was based. The profiles in Figures 11, 12, and 13 compare the pre- and post-renovation results of the prototype and control groups. The results are plotted on the five-point Likert scale. The profiles are presented for comparison with the following distinctions: (1) the solid heavy line is the POST-RENOVATION PROTOTYPE, (2) the dashed line is the PRE-RENOVATION PROTOTYPE (i.e., the "before" condition), and (3) the shaded band represents the range for the CONTROL GROUP in the "before" and "after" conditions, with the right side of the band being the PRE-RENOVATION CONTROL and the left side of the band being the POST-RENOVATION CONTROL.

Inspection of the three profiles shows the shifts in attitude ratings in terms of each scale. A series of two-tailed T tests was run to determine if there were statistically significant changes; the mean scores were compared in the "before and after" PROTOTYPE and in the "before and after" CONTROL groups. (Under ideal circumstances, one would expect few or no changes in the control group.) Significant differences are given on the profile. A significant difference in mean scores (at the .05 level) between the "before" and "after" conditions for the PROTOTYPE is represented by the letter "p," and

Overall, the only privacy factor showing a significant difference in the "before" and "after" conditions for the prototype group was "people entering the room and disturbing me"; there was no difference on any of the control group scales. There were some shifts toward positive ratings for the prototype group on scales of noise, control over privacy, and visual distractions; however, these are only significant at the .10 level, not at the .05 level selected for this analysis. Therefore, there were not many significant improvements in privacy. However, it is not clear if this was due to the design parameters or to the actual nature of the work function within the team structure.

Three regression models were used to evaluate the success of the prototype and the stability of the variables. These were concerned with the "area the space occupies is adequate for my tasks," the "privacy I have is adequate for my tasks," and "satisfaction with furniture generally." Each of these regressions was run on pre-renovation, post-renovation, and pre- and post-control groups to compare the shift in variables. Since a variable in a regression equation suggests that the item it represents is important in accounting for some portion of the model variance, the appearance or absence of that variable in a "before and after" condition indicates that some change has occurred.

The elimination of a variable in a regression model in the "after" condition does not indicate that there is a general improvement in satisfaction overall, but simply that that particular variable is no longer a problem to the people involved in the experiment. Therefore, it is possible to identify how the variables appear in the "before" and "after" conditions and determine which of them may be more important for design conclusions. Table 20 describes the major variables selected for regression modeling and interprets their results.

Table 20

Regression Models for Adequate Area

Question: "The Area My Space Occupies is Adequate for My Tasks"

		R^2	N
Pre-Renovation:	Area Adequate = 1.13 + .585 (Flex. workstation)	.34	24
Pre-Control:	Area Adequate = -.835 + .373 (Desk size) + ..33 (Flex. workstation) + .294 (Storage adequate)	.77	27
Post-Renovation:	Area Adequate = -.497 + .734 (Desk size) + .793 (Adequate privacy)	.72	28
Post-Control:	Area Adequate = .249 + .890 (Flex. workstation)	.50	29

The workstation's ability to accommodate different tasks is a problem in three of the four conditions. Occupants perceive this rather intangible variable to be quite important. The variable only disappears from the regression in the post-renovation conditions, indicating that the design for the new workstations has eliminated it as an irritant. However, in the post-renovation condition, concern with adequacy of privacy and desk size is noted. Changes in adequacy of privacy are best understood when viewed in the context of the privacy regressions (Table 21), since this variable now seems to be more important and is also a post-renovation problem. The desk size factor also appears again, while it did not in the pre-renovation condition. The prototype desks had desk carrel units which took up some space on the desk surface. This should not have caused this variable to be a problem; however, the change in surface area (i.e., from a desk surface to storage carrels) is perceived as partly adequate. A possible explanation is that after the renovation, many of the large tables which were formerly used to lay out computer listings had to be eliminated.

Table 21

Regression Models for Adequate Privacy

Question: "The Privacy I Have Is Adequate For My Tasks"

		R^2	N
Pre-Renovation:	Privacy Adequate = 5.80 - .870 (Telephone disturbs)	.59	15
Pre-Control:	Privacy Adequate = 5.96 - .485 (Telephone disturbs) - .454 (Conversation disturbs)	.45	27
Post-Control:	Privacy Adequate = 5.18 - .643 (Conversation disturbs)	.23	28
Post-Renovation:	Privacy Adequate = 2.14 - .850 (Noise through walls) + .662 (Control over privacy)	.53	15

Table 21 summarizes the adequacy of privacy in the "before" and "after" conditions for the control and renovation groups. Privacy regression comparisons can provide some interesting interpretation. Although phone noise is perceived as a problem in pre-renovation and pre-control, it is not a problem in either post-condition. In the control group, conversational noise continues to be a problem, which one would expect, since no changes were made. However, in the post-renovation, noise through walls and control over privacy were perceived to be problems. In the pre-renovation conditions, there were no walls separating individuals. Therefore, the addition of walls or partitions between workstations should have increased overall privacy. However, the new workstation layout gives the perception that there is no noise through the walls, since walls are now there.

The degree of control over personal privacy is a more difficult variable to interpret. Since the prototype experimental group was initially characterized as having a strong need for teamwork and consultative interaction, it is apparent that there would still be some intrusion of workstation areas. By lowering the workstation partition area to provide for quick conferencing, the designer may have lowered the degree of "control over privacy." However,

Since this is a perceived variable and there were no partitions between workstations before renovation, the regression model describes problems associated with a new configuration. It is doubtful that the control over privacy variable can be totally eliminated as a major factor in an organizational group which needs interactive consulting and coordination. This may simply be characteristic of their mode of work.

The satisfaction with furniture regression comparisons in Table 22 are interesting in that they perhaps show the interactive effects of management information and the occupant's desire to associate with a desirable outcome. In both post-renovation conditions, the major variable is pride. This is understandable for the renovated prototype, but not for the control group. The logical explanation seems to be that the control group thought that they would also get new furniture eventually, and therefore rated this category higher. The same explanation would be true for the "colorful" variable. This interpretation is reasonable since management had informed all personnel that they would all be included in the total renovation.

One difference in both the post-renovation and control groups is that "comfort" is no longer a regression component. In previous studies, comfort was associated with the chair itself. In this study, the old chairs were repainted and reupholstered. Therefore, it must be assumed that the entire workstation furnishings, not just the chairs, are contributing to an improved rating of comfort. Thus, the overall conclusion is that comfort has been increased; also, there is an emotional sense of identification with the project's success, even in those not included in the prototype area.

Generally, the prototype experiment improved employee attitudes toward their workstations over several variables. Although the total number of respondents in the experimental arrangement was relatively small, it was adequate to show some interesting shifts in perceptions in the "before" and "after" conditions; it also pointed out some variables which will affect how persons associated with computer-related job functions perceive the new workstations. However, the prototype experiment does not have a large enough sample group to identify major statistically significant changes in the area. It must be viewed as a supplement to both the previous survey and to the results of other experimental work dealing with requirements for workstations for computer-related job functions.

Table 22

Regression Models for Furniture Satisfaction

Question: "I Am Satisfied With the Furniture in My Workstation"

			R^2	N
Pre-Renovation:	SATFURN = 1.46	+ .407 (Furn. comfort)	.55	15
		+ .374 (High quality)		
Pre-Control:	SATFURN .205	+ .348 (Furn. comfort)	.54	27
		+ .629 (Modern style)		
Post-Renovation:	SATFURN 1.13	+ .462 (Proud of furn.)	.39	27
Post-Control:	SATFURN -1.55	+ .689 (Proud of furn.)	.77	29
		+ .592 (Colorful furn.)		

Productivity Evaluation Models

Productivity has always been a difficult concept to measure, particularly for white-collar workers, since their products are somewhat intangible (e.g., a computer program). Also, at a professional level, it is generally assumed that the employee will work to the best of his ability and will be self-motivated. Because of these difficulties, there are few productivity models for white collar work.

Researchers decided to construct a reasonable and logical model for productivity enhancement. The model would be a way to compare "before" and "after" conditions within the office setting. Although changes in management direction and changes in emphasis would affect ratings, it was thought that the model would still be useful in determining changes in the prototype test area.

A two-part approach was used to develop the model. The first part would measure physical variables (e.g., time away from desk). It was assumed that these variables might show improvement after renovation. The variables were selected from survey questions which the respondents answered subjectively; the responses were of a type that could be verified by observation. The second part of the approach would be selecting variables that would be subjectively evaluated, non-observable, and able to be constructed into a productivity scoring model. The combined improvement in both approaches could indicate productivity increases.

Factor in Productivity Changes

Time spent by an employee at his desk is a self-rated measure. If an individual is at his desk, he is assumed to be doing something work-related. There were three components to this factor of the productivity model: time spent writing, reading, and thinking (all were answered in previous questions). The assumption is that if more time is spent in any of these activities and thus, more time spent at the desk, the individual must be working harder (see Tables 23 and 24).

Table 23

Time Seated at Desk

	Hours	Prototype (%)	Control (%)
Pre-Renovation	1-2	0	0
	2-3	0	0
	3-4	20.0	3.6
	4+	80.0	96.4
Post-Renovation	1-2	0	0
	2-3	0	6.9
	3-4	11.1	6.9
	4+	88.9	86.2

Table 24

Activities While Seated at Desk

		Prototype	Control
Pre-Renovation	Write	26.9%	26.5%
	Read	14.0%	23.7%
	Think	27.3%	22.1%
Post-Renovation	Write	25.4%	20.1%
	Read	20.5%	21.4%
	Think	26.0%	33.0%

It is apparent that the scales used in this survey are not complete enough to handle the data adequately. At least 80 percent of the workers in each group spend more than 4 hours at their desks. Therefore, this question is not helpful. However, when asked to rate their activities at their desks, some useful differences appeared. Table 24 suggests that post-renovation prototype occupants spent 5.5 percent more time reading at their desks. It also appears that the control group now spends more time thinking than previously, but this is difficult to interpret properly. The small improvement in the reading activity is a very weak indication that productivity may be improved.

In terms of self-rated distances for work-related conversations, Table 25 reveals that longer distances were traveled after renovation; i.e., workers are walking longer distances to coordinate work-related problems. However, this data must be reviewed in conjunction with Table 26, which relates the number of business-related trips away from the workstation per day.

Table 25

Distance for Work-Related Conversations

	Distance (Feet)	Prototype (%)	Control Group (%)
Pre-Renovation	0-5	0.0	7.1
	5-10	40.0	10.7
	10-20	26.7	28.6
	20+	33.3	53.6
Post-Renovation	0-5	0.0	3.6
	5-10	29.4	32.1
	10-20	47.1	42.9
	20+	23.5	21.4

Table 26

Number of Business-Related Trips Per Day Away From Desk

	No. of Trips	Prototype (%)	Control Group (%)
Pre-Renovation	1-3	46.7	39.3
	4-5	26.6	21.4
	6-10	13.4	28.6
	11+	13.4	10.8
Post-Renovation	1-3	18.9	28.6
	4-5	43.8	28.6
	6-10	37.6	32.2
	11+	0.0	10.7

Table 26 shows that the percentage of business-related trips in the post-renovation condition has decreased dramatically in the one to three trips-per-day range, but has evened out in the mid-range. Also, there are no responses in the 15+ range in the "after" condition, indicating that the top end of the scales for numerous trips was reduced.

In terms of the data in Table 25, this means that there are generally fewer trips being made at the scale extremes. This indicates that the worker must be somewhat more productive, since he seems to be selecting longer, but seemingly more necessary, trips away from his workstation.

Distractions and interruptions indicate a lack of control over privacy and a hindrance to productive work. They can be deemed negative indicators of productivity. Tables 27 and 28 suggest some interesting interpretations.

Table 27

Frequency of Interruptions/Desk/Day

	No. Inter.	Prototype (%)	Control Group (%)
Pre-Renovation	0-2	26.7	14.8
	3-5	26.7	25.9
	6-10	26.7	18.5
	11+	20.0	40.7
Post-Renovation	0-2	20.0	11.5
	3-5	40.0	19.2
	6-10	26.6	49.9
	11+	13.4	19.1

Table 28

Frequency of Distractions while Seated at Desk/Day

	No. Distractions/Day	Prototype (%)	Control Group (%)
Pre-Renovation	0-4	40.0	50.1
	5-10	33.3	42.9
	11-20	13.3	7.2
	21+	13.4	0.0
Post-Renovation	0-4	49.9	11.5
	5-10	35.7	38.3
	11-20	14.2	38.4
	21+		11.4

Table 27 shows little change in the frequency of self-reported interruptions during the day. This lack of significant change could indicate that (1) either the renovation made no difference in these variables or (2) the organizational social contacts required for the work remained the same, and therefore, with the level of work effort maintained, one would expect no change. Table 28 shows little change in the frequency of distractions at the desk during the day in either the "before" or "after" conditions. There are not enough variables in the survey to determine whether these items can be used as productivity indicators for the observable model.

[illegible] Productivity Model

There have been some studies of the effect of the physical environment on productivity. The most notable of these[9] defines product vity in terms of an educational model; i.e., earned college credits per unit of floor area. This study determined that the use of new furnishings promoted a higher space utilization, and therefore more "production of earned credits" per unit floor area. However, this definition is not directly applicable to the DSAC study, since the output is much harder to define in terms of logic and functional computer support systems.

An article by Mundel[10] provides another discussion of productivity in relation to the operation of large corporations and the determination of measures. However, this study relates productivity to business costs--a set of parameters too far away from the workstation to have any meaning for design. Miller[11] has presented the relationship between the environment and productivity as it is affected by some aspects of facility design. He has suggested that the attitudes of corporate managers toward their staff may be

[illegible] Influence on Productivity (Herman Miller Research Corporation, [illegible]).

[illegible] M. Mundel, "Measures of Productivity," Industrial Engineer (May 1976).

[illegible] Management of the Working Environment (Hutchinson, Benham, London, 1975).

changed by changes in the physical environment. This thesis is part of the basis for the construction of the DSAC productivity model.

To create a logical and valid productivity score, we must first recognize that we are dealing with an intellectual environment in which the product may be improved logic for a sophisticated computer program (i.e., a mental product). Then, we must take the individual scores for respondents to each of the survey items mentioned above, normalize the individual scores to make sure all variables are being measured on the same dimensionless scale, and then compute an overall productivity score. Finally, this score must be compared with the control group scores to determine if the four-way experimental design indicated a statistically significant improvement, thereby suggesting that productivity was truly improved. Since the only known change in the prototype area was the implementation of the renovation design itself, the change, if any, must be attributed to the new prototype; therefore, the null hypothesis that "the renovation does <u>not make</u> a difference to productivity" must be rejected.

The productivity model which was considered best consisted of three components in Eq 1.

Productivity score = (standards of quality) + (managerial stimulation and direction) + (perceived productivity and relationship to other groups) [Eq 1]

The first action in verifying productivity improvements is to examine the tabular results from the frequencies to the three questions which make up the model. These are summarized in Tables 29, 30, and 31.

Table 29

Quality Standards
Management Emphasizes
High-Performance Standards

	Prototype	Control
Pre-Renovation	40%	54%
Post-Renovation	88%	39%
	N=18	N=28

Table 30

Performance Standards
Management Shows How To
Improve Performance

	Prototype	Control
Pre-Renovation	40%	28%
Post-Renovation	18%	22%
	N=18	N=28

Table 31

Productivity Comparison

My Branch Is More Productive Than Other Branches

	Prototype	Control
Pre-Renovation	53%	57%
Post-Renovation	94%	54%
	N=18	N=28

An examination of the individual performance percentages for the three components indicates some interesting tendencies. In the tables for quality standards and productivity, there is a rather dramatic increase in the post-renovation prototype; this indicates that these variables are being affected by the change in environment. However, there is a decrease in the table on management's intent to improve performance. In fact, the greatest change is in the post-renovation prototype. Interpreting this change is difficult, since there are many possibilities. For example, did the work character change for the occupants; is the N too small to determine a shift (the occupants rating this variable negatively remained stable in all cells); or does management need to exercise much less control in the renovated prototype? Generally, there is a major improvement in two of the three parameters, with a difficult interpretation in the third.

Now the construction of the normalized productivity model can be examined. The first factor was quality standards--a managerial factor. This factor was selected because it represents the maintenance of certain quality standards for the type of work being done. This indicates that more productivity is not necessarily better productivity and therefore sets a minimum for the quality of being accepted.

The component is management's attempts to improve individual employee performance; i.e., managers are exercising their authority for the good of the group in order to improve the working capability and productivity of individual employees within their teams. Together, these two factors represent managerial supervisory input into the productivity model.

Finally, there is the factor of perceived productivity; i.e., a "my group is more productive than your group" type of measure. This is a subjective evaluation by the survey respondent, since there are no direct measures of this type of productivity. This self-related question represents the peer group evaluation of relative productivity. Table 32 gives the productivity scores for the four groups.

Table 32

Normalized Productivity Model Scores

	Prototype	Control Groups
Pre-Renovation	.64	1.52
Post-Renovation	5.21	.42
	N = 18 (Sign. increase at .05 level)	N = 18 (Sign. decrease at .05 level)

The null hypothesis (of no change) was then rejected and it was assumed that the major renovation change in the organization's operation over the experimental period was responsible for the improvement in productivity. However, the degree of improvement cannot be stated with certainty; also, it is not known exactly how the renovation affects all the variables. However, within the limits of the model, it can be stated that there is statistically significant improvement in the productivity score, which may be attributable to the specific design features of the prototype area.

8 SUMMARY AND CONCLUSIONS

This study evaluated the six computer-related job functions in order to design new workstations that will improve the working environment. Within the limitations of the experimental prototype design and the statistical analysis of the survey data, design recommendations were made. The research showed that although different designs are needed for various job types, there are certain similar needs among individuals who work with computer-related work stations and team-type environments.

The methodology used in this study and the data it produced show that within specific constraints, it is possible to evaluate an office environment and to recommend design factors which will improve habitability satisfaction. Such recommendations identify major problem areas which need the attention of designers and architects. These problems may be solved to some extent by increased attention to layout design, flexibility, area, and organization character.

At DSAC, parameters were identified which are mainly job-related and related to the operations of modern computer technology. Although the DSAC environment is not that of a typical modern office, the employees do work with the latest computer technology.

The data analysis showed that across all job function groups, there are certain variables which affect facility design and layout. In a professional, computer-related environment, satisfaction with furniture is probably related to pride in the workstation design and professional image. Satisfaction with the workstation is generally related to professional image. Adequacy of work space is almost always related to adequacy of the desk area, rather than the surrounding territory of the office environment. This implies that an efficient office arrangement which is small in terms of number of square feet per person can still be rated highly. Finally, privacy in most computer-related workstations seems to be directly related to control over privacy and reduction of noise through walls. This presumes some design requirements for controlling interruptions and distractions.

A productivity model was constructed to help determine the major components of productivity and the effect of the changes in the working environment on productivity. The results showed that the renovation, even with the limitations placed on design actions, improved employee productivity.

In the DSAC study, the prototype experiment was successful in that it showed a definite improvement in occupant satisfaction. The employee survey was a useful resource for determining the relationship of employees to computer-related workstations.

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APPENDIX : Office Environment Questionnaire

US Army Corps
of Engineers
Construction Engineering
Research Laboratory

office environment
dla / dsac study

office research and planning study

A study to determine the best means of improving office space for the DLA/Defense Systems Automation Center has been requested. The purpose of this study is to determine the opinions, preferences and a consensus of complaints about offices that will help the designers to improve the efficiency, comfort and attractiveness of your building. As a resident of your office area, your experience, opinions and preferences will be highly valuable sources of information to the designer concerning layout, comfort and general features of decor and construction.

This questionnaire represents a portion of that study. Your help in answering items on this questionnaire will provide a basis for improving the office situation at DSAC. This questionnaire is divided into three sections:

Section I — Work Area Evaluation dealing with your immediate work area.

Section II — Activity and Equipment Analysis dealing with your functional needs

Section III — Work Environment dealing with organizational operations

The information requested by this survey will be used for research purposes only and all responses will be held in strict confidence. Your name will not be linked with your answers which will be used only for statistical summaries of the data.

Please complete the questionnaire before the next day and return it to one of CERL's representatives, or a common pick-up point.

Your cooperation and assistance are greatly appreciated. If you have any questions, please contact one of the CERL's researchers or call me at the FTS number below.

Dr. Charles C. Lozar
Research Architect
Principal Investigator
(FTS 958-7247)

BACKGROUND INFORMATION

169. Sex: _____Female ____Male 23 Branch or organization symbol____ 23 25

170. Discipline (Professional) _____ 26 27

171. My room number is _____ (If not assigned a specific room then indicate where most work is done_____). 28 30

172. How many years of education have you completed? (After high school)___ 31 32

173. Check the highest degree obtained. 33

1. Not a high school graduate
2. High school diploma
3. Junior College degree
4. Bachelor's degree
5. Master's degree
6. Doctorate
7. Post-Doctoral work

174. Are you defined by regulations as: 34

1. Supervisor
2. Computer Programmer
3. Systems Analyst
4. Function Analyst
5. Data Processing Clerk
6. Secretary

175. Do you have a professional certification? 1. Yes 2. No 35

176. How many years have you worked here? ____Yrs. 36 38

177. What is your present pay grade? _____(GS Level) 39 40

178. Is your appointment: 1. Permanent 2. Temporary 41

179. To the best of your ability, indicate the percentage of time you spend in each of the following activities during an average day. The total should equal 100% (select only those activities that apply).

_____Writing	42	_____Thinking	49
_____Reading	43	_____Drawings	50
_____Talking	44	_____Painting	51
_____Layout	45	_____Typing	52
_____Filing	46	_____Sorting	53
_____Collating	47	_____Mailing	54
_____Other	48	100% TOTAL	

180. If you have any suggestions for improving offices or if you wish to comment on anything not covered in the questionnaire, please do so below. (Do so below or on reverse side)

COLOR AND DECOR

166. If you were to paint your area, what would you choose as the MAIN COLOR or COLOR SCHEME? (circle one) 18

RED or SHADES OF RED.....1
GREEN or SHADES OF GREEN.....2
BLUE or SHADES OF BLUE.....3
BROWN or SHADES OF BROWN.....4
YELLOW or SHADES OF YELLOW.....5
ORANGE or SHADES OF ORANGE.....6
OTHER (specify).....

167. Would you prefer your color scheme: 19

Brightly colored rooms	1
Subdued colored rooms	2
Neutral colored rooms	3
Two colors in one room	4
One major color with accents	5

168. There could be a number of decor items displayed in the halls. If you had your choice, what would you like to see displayed in hallways. 20-21

_____Representational paintings

_____Abstract modern paintings

_____Displays of research

_____DLA recent work

_____Automation related paintings

_____Absolutely nothing on walls

_____Sculpture hung on walls

_____Areas for personal displays of employee's work

_____Supergraphic symbols identifying functional areas

_____Other _____

_____

The laboratory exists in an open site. Some aspects of the landscaping may be important to you. Please indicate your agreement or disagreement with the following statements.

SITE AND LANDSCAPING	Highly Agree	Slightly Agree	Neutral	Slightly Disagree	Highly Disagree	
156. Finding parking place close to the building is a problem	___	___	___	___	___	9
157. I like to spend time outdoors during my lunch hour	___	___	___	___	___	10
158. The inclusion of more trees around the building would improve its looks	___	___	___	___	___	11
159. I enjoy watching activity outside while working.	___	___	___	___	___	12
160. The landscaping makes this a pleasant place to be	___	___	___	___	___	13
161. I would like more outdoor recreation spots such as benches, covered places, etc.	___	___	___	___	___	14
162. I would enjoy plants in the interior of the building	___	___	___	___	___	15
163. Going outside during the day helps my ability to concentrate	___	___	___	___	___	16
164. The size of the parking lot is adequate	___	___	___	___	___	17

165. What single action would most improve the quality of the landscaping.

• *Perhaps at this time a cup of coffee would be a great help in continuing . . .*

PARTS OF THE OFFICE ENVIRONMENT

A building if made of many parts such as halls, conference rooms, etc. Your ratings of these components will help in an overall evaluation of office space.

HALLWAYS

125.	colorful	___ :	___ :	___ :	___ :	___ :	___ :	___	drab	55
126.	interesting	___ :	___ :	___ :	___ :	___ :	___ :	___	boring	56
127.	dark	___ :	___ :	___ :	___ :	___ :	___ :	___	light	57
128.	clean	___ :	___ :	___ :	___ :	___ :	___ :	___	dirty	58
129.	friendly	___ :	___ :	___ :	___ :	___ :	___ :	___	hostile	59
130.	beautiful	___ :	___ :	___ :	___ :	___ :	___ :	___	ugly	60

RECEPTIONIST AREA

131.	colorful	___ :	___ :	___ :	___ :	___ :	___ :	___	drab	61
132.	interesting	___ :	___ :	___ :	___ :	___ :	___ :	___	boring	62
133.	dark	___ :	___ :	___ :	___ :	___ :	___ :	___	light	63
134.	clean	___ :	___ :	___ :	___ :	___ :	___ :	___	dirty	64
135.	friendly	___ :	___ :	___ :	___ :	___ :	___ :	___	hostile	65
136.	beautiful	___ :	___ :	___ :	___ :	___ :	___ :	___	ugly	66

CONFERENCE ROOMS

137.	colorful	___ :	___ :	___ :	___ :	___ :	___ :	___	drab	67
138.	interesting	___ :	___ :	___ :	___ :	___ :	___ :	___	boring	68
139.	dark	___ :	___ :	___ :	___ :	___ :	___ :	___	light	69
140.	clean	___ :	___ :	___ :	___ :	___ :	___ :	___	dirty	70
141.	friendly	___ :	___ :	___ :	___ :	___ :	___ :	___	hostile	71
142.	beautiful	___ :	___ :	___ :	___ :	___ :	___ :	___	ugly	72
143.	adequate	___ :	___ :	___ :	___ :	___ :	___ :	___	inadequate	73

SNACKBAR (IF APPLICABLE)

144.	colorful	___ :	___ :	___ :	___ :	___ :	___ :	___	drab	74
145.	interesting	___ :	___ :	___ :	___ :	___ :	___ :	___	boring	75
146.	dark	___ :	___ :	___ :	___ :	___ :	___ :	___	light	76
147.	clean	___ :	___ :	___ :	___ :	___ :	___ :	___	dirty	77
148.	friendly	___ :	___ :	___ :	___ :	___ :	___ :	___	hostile	78
149.	beautiful	___ :	___ :	___ :	___ :	___ :	___ :	___	ugly	79 80
150.	adequate	___ :	___ :	___ :	___ :	___ :	___ :	___	inadequate	3 1

LIBRARY (IF APPLICABLE)

151.	colorful	___ :	___ :	___ :	___ :	___ :	___ :	___	drab	2
152.	interesting	___ :	___ :	___ :	___ :	___ :	___ :	___	boring	3
153.	dark	___ :	___ :	___ :	___ :	___ :	___ :	___	light	4
154.	clean	___ :	___ :	___ :	___ :	___ :	___ :	___	dirty	5
155.	friendly	___ :	___ :	___ :	___ :	___ :	___ :	___	hostile	6
156.	beautiful	___ :	___ :	___ :	___ :	___ :	___ :	___	ugly	7
157.	adequate	___ :	___ :	___ :	___ :	___ :	___ :	___	inadequate	8

IMAGE OF THE BUILDING

The exterior of the DLA building presents an image to the public, consultants, and new employees. Please indicate your rating of the exterior image of the DLA building on the scales below by placing a check mark close to the adjective which best describes some attribute of the exterior. Rate all scales.

102.	common	___ :	___ :	___ :	___ :	___ :	___ :	___	unique	32
103.	dark	___ :	___ :	___ :	___ :	___ :	___ :	___	light	33
104.	useful	___ :	___ :	___ :	___ :	___ :	___ :	___	useless	34
105.	delicate	___ :	___ :	___ :	___ :	___ :	___ :	___	rugged	35
106.	active	___ :	___ :	___ :	___ :	___ :	___ :	___	passive	36
107.	ordered	___ :	___ :	___ :	___ :	___ :	___ :	___	chaotic	37
108.	old	___ :	___ :	___ :	___ :	___ :	___ :	___	new	38
109.	colorless	___ :	___ :	___ :	___ :	___ :	___ :	___	colorful	39
110.	flexible	___ :	___ :	___ :	___ :	___ :	___ :	___	rigid	40
111.	expensive	___ :	___ :	___ :	___ :	___ :	___ :	___	inexpensive	41
112.	calming	___ :	___ :	___ :	___ :	___ :	___ :	___	exciting	42
113.	small	___ :	___ :	___ :	___ :	___ :	___ :	___	large	43
114.	simple	___ :	___ :	___ :	___ :	___ :	___ :	___	complex	44
115.	pleasing	___ :	___ :	___ :	___ :	___ :	___ :	___	annoying	45
116.	formal	___ :	___ :	___ :	___ :	___ :	___ :	___	casual	46
117.	dull	___ :	___ :	___ :	___ :	___ :	___ :	___	bright	47
118.	friendly	___ :	___ :	___ :	___ :	___ :	___ :	___	hostile	48
119.	boring	___ :	___ :	___ :	___ :	___ :	___ :	___	interesting	49
120.	generous	___ :	___ :	___ :	___ :	___ :	___ :	___	frugal	50
121.	traditional	___ :	___ :	___ :	___ :	___ :	___ :	___	contemporary	51
122.	beautiful	___ :	___ :	___ :	___ :	___ :	___ :	___	ugly	52
123.	subdued	___ :	___ :	___ :	___ :	___ :	___ :	___	vibrant	53
124.	cheerful	___ :	___ :	___ :	___ :	___ :	___ :	___	sad	54

PERSONALIZATION OF WORK STATION

We all tend to bring parts of our lives into the office setting. Sometimes we bring in objects that symbolize aspects of our lives and place them in the office areas. The following questions deal with this kind of personalization.

97. Do you bring objects from home or elsewhere with which to decorate your room or work station?

_____Yes _____No (if no skip to question 102) 29

98. If yes, please indicate the type of objects you bring. Circle one or more. 30-31

1. Photos	8. Desk ornaments
2. Pictures	9. Wall hangings
3. Posters	10. Certificates, awards
4. Pencil holders	11. Personal lamp
5. Coffee cups	12. Radio
6. Personal books	13. Clock
7. Plant	14. Other _____

99. Can you explain, in your own words, why you bring these items to the office setting?

100. Do your friends talk about these items when visiting your work station?

101. Does your work station accommodate this form of personalization or would you prefer more places to put your items.

PRIVACY IN WORK STATION

Privacy has many definitions, but seems to be a concept related to the nature of your tasks at your work station and in your room. Please indicate your degree of agreement with the following statements.

		Highly Agree	Slightly Agree	Neutral	Slightly Disagree	Highly Disagree	
88.	Conversations in my room disturb my ability to concentrate	___	___	___	___	___	20
89.	I can hear noise thru the walls of my office	___	___	___	___	___	21
90.	People keep coming into my room and disturbing me	___	___	___	___	___	22
91.	The telephones in my room are a noise irritant	___	___	___	___	___	23
92.	I have a high degree of control overy my privacy in my room	___	___	___	___	___	24
93.	I have many visual distractions in my office which are disturbing	___	___	___	___	___	25
94.	My job requires a high degree of concentration	___	___	___	___	___	26

95. Total number of people in my room is _____. 27

96. Number of people I can see while sitting at my desk is_____. 28

ELECTRICAL OUTLETS IN ROOM

80.	Sufficient number	___:___:___:___:___:___:___	Insufficient number	3
81.	Well located	___:___:___:___:___:___:___	Poorly located	4

AIR CONDITIONING AND HEATING IN ROOM

82.	Air Conditioning Adequate	___:___:___:___:___:___:___	Air Conditioning Not Adequate	5
83.	Heating Adequate	___:___:___:___:___:___:___	Heating Inadequate	6
84.	Easy to Adjust	___:___:___:___:___:___:___	Hard to Adjust	7
85.	I am comfortable in most seasons	___:___:___:___:___:___:___	I am uncomfortable in most seasons	8

THERMAL COMFORT AT WORK STATION

86. Please rate the Thermal Conditions at your work station now as you are completing this questionnaire. 9

_____Cold

_____Cool

_____Slightly Cool

_____Comfortable

_____Slightly Warm

_____Warm

_____Hot

87. Please indicate which items of clothing best describe your apparel right now. Clothing has a significant effect upon thermal comfort and needs to be accounted for in our analysis. 10-1

	MEN	WOMEN
Slacks plus:	short sleeve shirt___	skirt___
	long sleeve shirt___	slacks___
	undershirt___	blouse___
	sweater or sweater ve t___	sweater___
	suit coat or sports jacket___	jacket___

FLOORING IN ROOM

64.	Satisfactory	___:___:___:___:___:___:___	Unsatisfactory	67
65.	Clean	___:___:___:___:___:___:___	Dirty	68
66.	In good repair	___:___:___:___:___:___:___	In poor repair	69
67.	Attractive	___:___:___:___:___:___:___	Unattractive	70

CEILING IN ROOM

68.	Satisfactory	___:___:___:___:___:___:___	Unsatisfactory	71
69.	In good repair	___:___:___:___:___:___:___	In poor repair	72
70.	Attractive finish	___:___:___:___:___:___:___	Unattractive finish	73

WALLS IN ROOM

71.	Satisfactory	___:___:___:___:___:___:___	Unsatisfactory	74
72.	Easy to clean	___:___:___:___:___:___:___	Difficult to clean	75
73.	In good repair	___:___:___:___:___:___:___	In poor repair	76
74.	Attractive finish	___:___:___:___:___:___:___	Unattractive finish	77
75.	Good quality paint	___:___:___:___:___:___:___	Poor quality paint	78

UTILITIES AND SERVICES IN ROOM

76.	Lighting adequate	___:___:___:___:___:___:___	Lighting inadequate	79
77.	Fixtures well located	___:___:___:___:___:___:___	Fixtures poorly located	80
78.	Switches well located	___:___:___:___:___:___:___	Switches poorly located	2 1
79.	Switches in good repair	___:___:___:___:___:___:___	Switches in poor repair	2

ROOM

Your work station is in a room. Certain attributes of this room can be rated individually and make up your total perception of your space in the room. Please answer the following questions.

WINDOWS

51. How important is it for you to be able to see outside?

Extremely important ___:___:___:___:___:___:___ Not important at all 54

52. Do you feel having a window is a factor in your ability to do your job?

_____ Yes _____ No 55

53. Do you feel a window

Improves my performance on the job ___:___:___:___:___:___:___ Distracts from my performance on the job 56

54. Can you see out of any window from where you normally sit?

_____ Yes _____ No (If no go on to 64) 57

55. If so what can you see? (circle as many as necessary)

1. trees 2. cars 3. fields 4. buildings 5. supplies 6. trash 58

56. Which direction does your window face?

_____ North _____ East _____ South _____ West 59

WINDOWS IN ROOM

57. Satisfactory ___:___:___:___:___:___:___ Unsatisfactory 60

58. Style attractive ___:___:___:___:___:___:___ Style unattractive 61

59. Provides adequate outside light ___:___:___:___:___:___:___ Provides inadequate outside light 62

60. Good location ___:___:___:___:___:___:___ Poor location 63

61. Good size ___:___:___:___:___:___:___ Poor size 64

62. Clean glass ___:___:___:___:___:___:___ Dirty Glass 65

63. Easy to open or operate ___:___:___:___:___:___:___ Difficult to open or operate 66

IMAGE OF WORK STATION AND ROOM

The work station you work with presents an image to you, your visitors, and other staff. Please indicate your rating of the image of your work station on the scales below by placing a check mark close to the adjective which best describes its attributes.

28.	cozy	___ :	___ :	___ :	___ :	___ :	___ :	___	roomy	31
29.	common	___ :	___ :	___ :	___ :	___ :	___ :	___	unique	32
30.	clean	___ :	___ :	___ :	___ :	___ :	___ :	___	dirty	33
31.	dark	___ :	___ :	___ :	___ :	___ :	___ :	___	light	34
32.	bad	___ :	___ :	___ :	___ :	___ :	___ :	___	good	35
33.	ordered	___ :	___ :	___ :	___ :	___ :	___ :	___	chaotic	36
34.	old	___ :	___ :	___ :	___ :	___ :	___ :	___	new	37
35.	colorless	___ :	___ :	___ :	___ :	___ :	___ :	___	colorful	38
36.	stuffy	___ :	___ :	___ :	___ :	___ :	___ :	___	drafty	39
37.	calming	___ :	___ :	___ :	___ :	___ :	___ :	___	exciting	40
38.	noisy	___ :	___ :	___ :	___ :	___ :	___ :	___	quiet	41
39.	small	___ :	___ :	___ :	___ :	___ :	___ :	___	large	42
40.	simple	___ :	___ :	___ :	___ :	___ :	___ :	___	complex	43
41.	pleasing	___ :	___ :	___ :	___ :	___ :	___ :	___	annoying	44
42.	formal	___ :	___ :	___ :	___ :	___ :	___ :	___	casual	45
43.	dull	___ :	___ :	___ :	___ :	___ :	___ :	___	bright	46
44.	friendly	___ :	___ :	___ :	___ :	___ :	___ :	___	hostile	47
45.	boring	___ :	___ :	___ :	___ :	___ :	___ :	___	interesting	48
46.	traditional	___ :	___ :	___ :	___ :	___ :	___ :	___	contemporary	49
47.	beautiful	___ :	___ :	___ :	___ :	___ :	___ :	___	ugly	50
48.	subdued	___ :	___ :	___ :	___ :	___ :	___ :	___	vibrant	51
49.	protected	___ :	___ :	___ :	___ :	___ :	___ :	___	exposed	52
50.	facilitating	___ :	___ :	___ :	___ :	___ :	___ :	___	distracting	53

WORK STATION

Your work station is the physical space in the room you and your office equipment occupy. Various aspects of your work station layout may affect your job performance. Please indicate the degree to which you agree or disagree with the following statements.

	Highly Agree	Agree Slightly	Neutral	Disagree Slightly	Highly Disagree	
16. The size of my desk surface is adequate for my tasks.	___	___	___	___	___	19
17. The area my space occupies is adequate for my tasks.	___	___	___	___	___	20
18. I have enough storage space in and around my desk.	___	___	___	___	___	21
19. I find my work station flexible enough to meet changing requirements.	___	___	___	___	___	22
20. I think my work station presents a professional image.	___	___	___	___	___	23
21. The privacy I now have is adequate for my tasks	___	___	___	___	___	24
22. My work station is an attractive arrangement	___	___	___	___	___	25
23. My work station is easy to keep clean	___	___	___	___	___	26
24. I do bring items from home to personalize my work area	___	___	___	___	___	27
25. There are no safety hazards associated with my work station.	___	___	___	___	___	28
26. I associate a personal sense of pride with my work station	___	___	___	___	___	29
27. Someone else has a work station I would prefer rather than mine	___	___	___	___	___	30

card 1
col. 1-3

Quest. No._____

FURNITURE

The furniture you have in your work station can help or hinder your job effectiveness. The furniture consists of a number of individual items which you will be asked to evaluate as a group. Please indicate your agreement or disagreement with the following statements.

	Highly Agree	Slightly Agree	Neutral	Slightly Disagree	Highly Disagree	
1. My furniture is comfortable	___ :	___ :	___ :	___ :	___	4
2. I have a wide variety of furniture	___ :	___ :	___ :	___ :	___	5
3. My furniture is modern and stylish	___ :	___ :	___ :	___ :	___	6
4. My furniture is colorful	___ :	___ :	___ :	___ :	___	7
5. My furniture is easy to damage	___ :	___ :	___ :	___ :	___	8
6. My furniture is new	___ :	___ :	___ :	___ :	___	9
7. I am proud of my furniture	___ :	___ :	___ :	___ :	___	10
8. My furniture is sturdy	___ :	___ :	___ :	___ :	___	11
9. My furniture is high quality	___ :	___ :	___ :	___ :	___	12
10. I am satisfied with the furniture in my work station	___ :	___ :	___ :	___ :	___	13

I have the following furniture in my work area (circle appropriate items)

11. Desk (14)
    1 Grey-green
    2 Wood
    3 Black with colored top

12. Bookcase (15)
    1 Bookshelves
    2 Metal Bookcase

13. File Cabinet (16)
    1 2 drawer
    2 4 drawer
    3 Slide pullout
    4 Wright Cabinet for Computer Files

14. Other Equipment (17)
    1 Cradenza
    2 Chairs
    3 Work Table
    4 Other

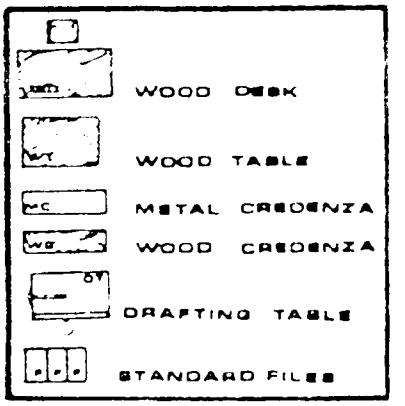
15. Partitions (18)
    1 Bank Screen
    2 Landscape Office
    3 Movable Freestanding
    4 None

SECTION I: WORK AREA EVALUATION

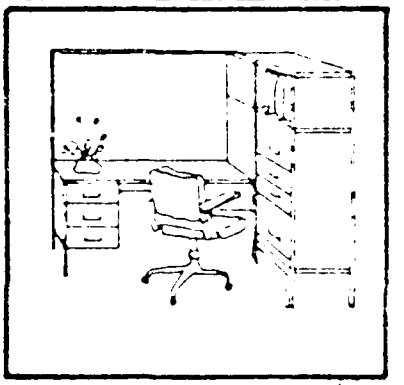
[illegible]

[illegible]

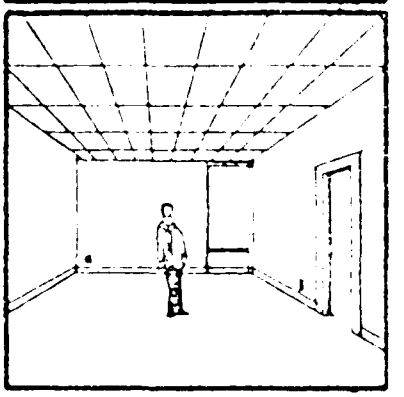
1. Furniture: The actual items such as desks, bookcases, chairs, etc.



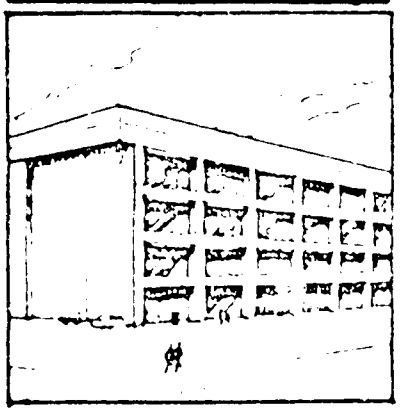
2. Work Station: The assemblage of furniture and accessories you have arranged to meet your needs for your tasks.



3. Room: The actual room in which you work or are stationed consisting of floors, walls, ceilings, and utilities.



4. Building: The whole of DLA as a building and a group of buildings.



2

SECTION II: EQUIPMENT AND ACTIVITY INVENTORY

The purpose of this questionnaire is to document your job related activities and equipment so that we can best specify furniture and equipment for your work area. Please read the instructions before beginning the questionnaire.

Please circle the appropriate items.

1. During an "average" work day how many trips will you personally make to a copy machine? 55

   a. None
   b. 1-3
   c. 4-6
   d. 7-9
   e. 10 or more

2. During an "average work week" how many conferences or meetings will you participate in? 56

   a. None
   b. 1-3
   c. 4-6
   d. 7-10
   e. More than 10

3. Where are your conferences most frequently held? 57

   a. At your own workspace or office
   b. In a private conference room
   c. At someone else's workspace

4. Not including yourself, how many other persons will usually participate in these conferences? 58

   a. One other person
   b. 2-3 other people
   c. 4-5 other people
   d. More than 5 people

5. What is the typical duration of these conferences? 59

   a. 1-10 minutes
   b. 10-30 minutes
   c. 30 minutes to 1 hour
   d. Over 1 hour

6. Does your job require you to operate a computer terminal? 60

   Yes
   No

Note: If you answered No on question 8, please skip to question 11, thank you.

7. Do you share use of a terminal with one of your co-workers? 61

Yes
No

8. During an "average" work day how many hours do you spend operating a terminal? 62

a. Less than 1 hour
b. 1-2 hours
c. 2-3 hours
d. 3-5 hours
e. over 5 hours

9. Does your job require you to work with computer print outs? 63

Yes
No

10. Are any of the files which you maintain or use, located in a central or department file area where more than one person retrieves information from them? 64

Yes
No

11. How often do you have visitors from outside this laboratory? 65

a. Never
b. Once or twice a month
c. Once or twice a week
d. Once or twice a day
e. More than twice a day

12. During an "average" work day how much time do you spend sitting at your desk/work station? 66

a. Less than 1 hour
b. 1-2 hours
c. 2-3 hours
d. 3-4 hours
e. More than 4 hours

13. Which of the following items do you have on your desk? Check as many items as appropriate.

a. Telephone 67
b. Dictaphone 68
c. Light 69
d. Stapler 70
e. Intercom 71
f. Address/directory 72
g. Tape dispenser 73
h. Personal items (like photographs, plants) 74
i. Calculator 75
j. Drafting equipment 76
k. Office machine (typewriter, etc.) 77
l. In/Out Basket 78
m. Paper punch 79
n. Blotter 1
o. Box of tissues 2
p. Ash tray 3
q. Desk calendar 4

14. How many of your desk drawers are filled with "working files", i.e. information which is referred to periodically throughout the day? 5

a. 1/2 drawer or less
b. 1 drawer
c. 2 drawers
d. More than 2 drawers

15. Are any of the files you maintain contained within standard filing cabinets? 6

Yes
No

16. How many of these standard file drawers (approximately 24" deep) are filled iwth "working files", i.e. information which is referred to periodically throughout the day? 7

a. None
b. 1/2 drawer
c. 1 drawer
d. 2 drawers
e. 3 drawers
f. 4 drawers
g. More than 4 drawers

17. How many of these standard file drawers are filled with "dead" files; i.e. information which must be kept but which is seldom retrieved? 8

a. None
b. 1-2 drawers
c. 3-6 drawers
d. 7-10 drawers
e. 11-16 drawers
f. More than 16 drawers

18. How adequate is the amount of filing space you currently use? 9

a. Very inadequate
b. Somewhat inadequate
c. Slightly inadequate
d. Barely adequate
e. Somewhat adequate
f. Very adequate

19. How many books, notebooks, folders, binders, etc., less than 1" thick do you currently store in your work space (office)? 10

a. None
b. 1-25
c. 26-50
d. 51-75
e. 76-100
f. over 100

20. How many catalogs, manuals, binders, notebooks, etc. from 1-3" thick do you currently store in your workspace (office)? 11

a. None
b. 1-12
c. 13-24
d. 25-36
e. 37-48
f. over 48

21. How many catalogs, binders, manuals, books, etc. over 3" thick do you currently store in your workspace (office)? 12

a. None
b. 1-4
c. 5-8
d. 9-16
e. 17-24
f. 25 or over

22. Do you store extra amounts of stationary, envelopes, business forms, slides, miscellaneous office supplies and other items which are not used on a daily basis? 13

Yes
No

23. Do you usually have large graphic materials on display such as: flow charts, bar charts, maps, posters, plans, etc.? 14

a. Never
b. Almost never
c. Infrequently
d. Sometimes
e. Frequently
f. Almost always

24. Would a chalkboard be of use in completing your daily job tasks? 15

a. Unnecessary
b. No particular feeling
c. Somewhat useful
d. Useful
e. Very useful

SECTION III: WORK ENVIRONMENT

The following questionnaire is designed to measure the ways you perceive and react to various aspects of your work environment. This information will be used to determine the effects of different conditions upon people who work in them. Recommendations will then be made regarding changes and improvements in the work area.

The questionnaire will require about 15 minutes of your time. This amount of time is necessary for us to obtain a more real picture of the conditions which presently exist so that we might make more meaningful suggestions for change.

Please read each question carefully and answer it thoughtfully. The information you provide is CONFIDENTIAL AND FOR RESEARCH PURPOSES ONLY. NO INFORMATION REGARDING INDIVIDUAL RESPONSES WILL BE DIVULGED.

Thank you for your help.

DO NOT PUT
YOUR NAME
ON THIS QUESTIONNAIRE

(In this section, branch is used to define your organizational element. Organization refers to the laboratory as a whole)

1. How often is the amount of light, heat, or air in your work areas so bad that it bothers you? 16

   a. Almost always
   b. Usually
   c. Sometimes
   e. Seldom
   f. Almost never

2. How often do you feel unable to satisfy the conflicting demands of various people over you? 17

   a. Never
   b. Rarely
   c. Sometimes
   d. Often
   e. Almost always

3. Opportunities for independent thought and action on my job are: 18

   a. Non-existent
   b. Limited
   c. Fairly good
   d. Quite good
   e. Outstanding

4. How often do you have opportunities to work on different jobs? 19

   a. Never
   b. Rarely
   c. Sometimes
   d. Often
   e. Nearly all the time

5. How many tasks do you perform on your job which you consider relatively unimportant or unnecessary? 20

   a. Nearly all
   b. Quite a number
   c. A few
   d. Very few
   e. Practically none

6. I usually have good information on where I stand and how my performance is evaluated. 21

   a. Strongly agree
   b. Agree
   c. Not sure
   d. Disagree

7. How often do you work on difficult and challenging problems in your job? 22

   a. Never
   b. Rarely
   c. Sometimes
   d. Rather often
   e. Nearly all the time

8. The condition of the equipment and supplies used in my work is: 23

   a. Poor
   b. Unsatisfactory
   c. Fair
   d. Good
   e. Excellent

9. To what extent are you required to follow a specified set of rules and procedures in doing your job? 24

   a. To a very great extent; I must follow rules and procedures exactly
   b. To a great extent; changes can very rarely be made
   c. To a moderate extent; changes can be made on some things but often I must follow set rules and procedures
   d. To a limited extent; there are only a few rules and procedures for my job
   e. Not at all; there are no specified rules and procedures for my job

10. Procedures are designed so that equipment is used efficiently 25

   a. Strongly agree
   b. Agree
   c. Not sure
   d. Disagree
   e. Strongly disagree

11. To what extent are you required to meet rigid standards of quality in your work? 26

   a. To a very great extent
   b. To a great extent
   c. To some extent
   d. To a small extent
   e. Not at all

12. To what extent is dealing with other people a part of your job? 27

a. Very little; working with other people is not an important part of my job
b. Somewhat; I have to deal with some other people, but this is not a major part of my job
c. Frequently; I deal with many other people as a part of my job
d. Very much; probably the single most important part of my job is working with other people

13. How well does your supervisor recognize and reward good performance by his people? 28

a. He is not a good supervisor in this respect
b. He recognizes good work but does little in the way of rewarding
c. He recognizes and rewards good work
d. He is very appreciative and eager to reward good work

14. To what extent does your supervisor emphasize high standards of performance? 29

a. Not at all
b. To a small extent
c. To some extent
d. To a great extent
e. To a very great extent

15. To what extent does your supervisor show you how to improve your performance? 30

a. Not at all
b. To a small extent
c. To some extent
d. To a great extent
e. To a very great extent

16. To what extent does your supervisor encourage the people who work for him to work as a team? 31

a. Not at all
b. To a small extent
c. To some extent
d. To a great extent
e. To a very great extent

17. Overall, how good a job do you feel is being done by your immediate supervisor? 32

a. Very good
b. Good
c. Fair
d. Poor
e. Very poor

18. How successful is your immediate supervisor in dealing with higher levels of command? 33

a. Outstandingly successful
b. Very successful
c. Definitely above average success
d. About average success
e. Below average success

19. The people here generally trust their branch heads. 34

a. Strongly agree
b. Agree
c. Not sure
d. Disagree
e. Strongly disagree

20. Everything is checked; individual judgment is not trusted 35

a. Strongly agree
b. Agree
c. Not sure
d. Disagree
e. Strongly disagree

21. The work space and furniture in our work group is: 36

a. Excellent
b. Good
c. Passable
d. Somewhat unsatisfactory
e. Poor

22. How does your branch compare to all other branches in the division in terms of productivity? 37

a. Is one of the most productive branches (top 5%)
b. Is considerably above average in productivity (top 20%)
c. Is somewhat above average in productivity (top 40%)
d. My branch has about average productivity for the district
e. Is somewhat below average in productivity

23. Most members of my Branch take pride in their jobs. 38

a. Strongly agree
b. Agree
c. Not sure
d. Disagree
e. Strongly disagree

24. To what extent does a friendly atmosphere prevail among most of the members of your Branch? 39

a. To a very small extent
b. To a small extent
c. To some extent
d. To a considerable extent

25. People are encouraged to ask questions about the Branch's affairs. 40

a. Strongly agree
b. Agree
c. Not sure
d. Disagre
e. Strongly disagree

26. In this organization about the only source of information on important matters is the grapevine (rumor). 41

a. Strongly agree
b. Agree
c. Not sure
d. Disagree
e. Strongly disagree

27. Generally there are friendly and cooperative relationships between the different branches in this organization. 42

a. Strongly agree
b. Agree
c. Not sure
d. Disagree
e. Strongly disagree

28. In this organization things seem to happen contrary to rules and regulations 43

a. Strongly agree
b. Agree
c. Not sure
d. Disagree
e. Strongly disagree

29. How clearly defined are the objectives of your Branch? 44

a. Sometimes obscure or poorly defined
b. Generally adequately defined
c. Better than most
d. Exceptionally well defined

30. How consistently are organization's policies applied to all? 45

a. Totally inconsistent
b. Inconsistent most of the time
c. Consistent most of the time
d. Completely consistent, all are treated the same

31. Working conditions in this Branch are better than in other Branches. 46

a. Strongly agree
b. Agree
c. Not sure
d. Disagree
e. Surely disagree

32. On the basis of your experience and information, how would you rate your Branch on effectiveness? 47

a. Very poor
b. Poor
c. Fair
d. Good
e. Very good

33. The cleanliness and up-keep of the rest rooms and other facilities we use is: 48

a. Very poor
b. Poor
c. Passable
d. Good
e. Very good

34. To what extent does your Branch emphasize personal growth and development? 49

a. Not at all
b. To a very small extent
c. To a small extent
d. To some extent
e. To a considerable extent

35. Superiors keep well-informed about the needs and problems of the people working here 50

a. Strongly agree
b. Agree
c. Not sure
d. Disagree
e. Strongly agree

36. How do you feel about recommending this organization to a prospective employee? 51

a. I would not recommend it under any circumstances
b. I would probably recommend it under certain circumstances
c. I would recommend it to most employees

37. Considering everything, how satisfied are you with your present job? 52

a. Very dissatisfied
b. Dissatisfied
c. Indifferent
d. Satisfied
e. Very satisfied

38. How often do you wish you could quite your present job? 53

a. About all the time
b. Very often
c. Somewhat often
d. Seldom
e. Never

39. Generally speaking, how satisfied are you with the kind of work you have to do on your job? 54

a. Very dissatisfied
b. Dissatisfied
c. Indifferent
d. Satisfied
e. Very satisfied

AD-A151 938 DESIGN OF COMPUTER-RELATED WORKSTATIONS IN RELATION TO JOB FUNCTIONS AND..(U) CONSTRUCTION ENGINEERING RESEARCH LAB (ARMY) CHAMPAIGN IL C C LOZAR ET AL. 2/2

UNCLASSIFIED DEC 84 CERL-P-85/09 MIPR-80-939-5 F/G 5/5 NL

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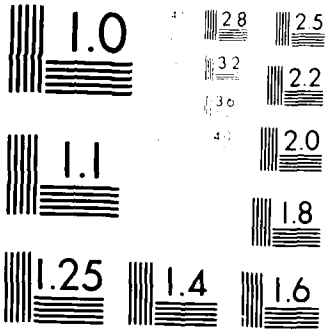

MICROCOPY RESOLUTION TEST CHART

40. Considering everything, how would you rate your overall satisfaction in this Branch at the present time? 55

a. Very dissatisfied
b. Dissatisfied
c. Indifferent
d. Satisfied
e. Very satisfied

41. Your branch or office symbol _____ 56 59

42. Are you: 60

a. Administrative/support
b. Professional/technical

43. Are your responsibilities classified as: 61

a. Supervisory and management
b. Computer Programmer
c. Systems Analyst
d. Functional Analyst
e. Clerk
f. Secretary

.....And now, the last page. Please answer the following questions and turn in your questionnaire to the PERT Conference Room in the front of DSAC.

1. The distance I must travel for most work related conversations is:

   0-5 ft._____
   5-10 ft._____
   10-20 ft._____
   20 or more_____

2. The number of business related trips I make away from the work station is about _____ per day:

3. The distance I generally travel for personal conversations is:

   0-5 ft_____
   5-10 ft_____
   10-20 ft_____
   20 or more_____

4. The number of personal trips I make away from the work station is about _____ per day.

5. Distractions are noises, passerbys, equipment noise, other telephones, etc. How many times per day would you esstimate you are distracted from your work by these causes. _____ times per day.

6. Interruptions are people intruding on your thinking during the day for any reason (including your phone) How many times per day would you estimate this happens? _____ times per day.

7. How many trips per day do you make to the cafeteria (including lunch)? _____Trips per day

---

Answer only if you are a Programmer or Analyst:
In your job function, one of the most frustrating activities is finding, fixing, or testing your mistakes ("Glitches" of all types) In computer-related work (writing, designing, or evaluating programs)

8. Estimate the number of your "glitches" per day you must deal with (As defined by you)
   Total Number_____

9. How much time per day would you estimate you spend fixing these self-created "Glitches"

   Total_____ Hours _____ Min _____

Additional Distribution

[illegible] Army Engineer Districts [illegible]
ATTN: Chief, Engineer Division

[illegible] Army Engineer Divisions [illegible]
ATTN: Chief, Engineer Division

USA TARCOM [illegible]
ATTN: DRDTA

Fort Leavenworth, KS 66027
ATTN: ATZLA-WI

Fort Belvoir, VA 22060
ATTN: [illegible]

Tyndall AFB, FL 32403
ATTN: [illegible]

Director, Civil Technology & Safety Div 20416

Director, Center for Civil Technology 20334

Director, Institute of Civil Sciences 20005

[illegible] 20406

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14 [illegible]

Lozar, Charles C
Design of computer-related workstations in relation to job functions and productivity / by Charles C. Lozar, Robert D. Neathammer. - Champaign, Ill. : Construction Engineering Research Laboratory, 1984)
46 pp. (Technical report ; P-85/09)

1. Defense Systems Automation Center, Columbus, Ohio. 2. Office furniture. 3. Work environment. 4. Computer terminals. I. Neathammer, Robert D. II. Title. III. Series : Technical report (Construction Engineering Research Laboratory) ; P-85/09.

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